



Assessment of Life Cycle Information Exchanges (LCie)

Understanding the Value-Added Benefit of a COBie Process

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Abstract

The Construction Operations Building information exchange (COBie) standard defines a minimum set of information needed to capture electronic construction handover information. COBie, however, does not define the specific processes used to create such information. Some designers and contractors may choose to capture the data by mirroring current document-based processes, transcribing information from required paper documents into a COBie-formatted file following beneficial occupancy. Other designers and contractors may choose to capture this information as data, as the work progresses, using COBie-centered project extranets. This report examines the costs and benefits of each approach, and compares them by analyzing differences in each business process that uses COBie information. The results indicate that a significant benefit may be achieved through the elimination of the non-value-added activities related to the handling, routing, transforming, checking, copying, and transmitting documents containing COBie data.

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Preface

This study was conducted for the US Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) and the National Institute of Building Sciences (NIBS) by Kristine Fallon Associates, Inc., under CRADA-07-CERL-02, "Cooperative Research and Development Agreement Between US Army Engineer Research and Development Center—Construction Engineering Laboratory and National Institute Of Building Sciences." The CRADA supports Research, Development, Test, and Evaluation (RDT&E) Program Element 622784 T41, "Military Facilities Engineering Technology"; Project 157249, "Life-Cycle Model For Mission Ready Sustainable Facilities (LCM)." The ERDC-CERL project manager was Dr. E. William East (CEERD-CF-N), and the NIBS project manager was Dana "Deke" Smith.

The work was supervised and monitored by the Engineering Processes Branch (CF-N) of the Facilities Division (CF), ERDC-CERL. At the time of publication, Donald K. Hicks was Chief, CEERD-CF-N; L. Michael Golish was Chief, CEERD-CF; and Martin J. Savoie was the Technical Director for Adaptive and Resilient Installations. The Deputy Director of ERDC-CERL was Dr. Kirankumar Topudurti and the Director was Dr. Ilker Adiguzel.

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COL Jeffrey R. Eckstein was the Commander of ERDC, and Dr. Jeffery P. Holland was the Director.

Unit Conversion Factors

Multiply	Ву	To Obtain
feet	0.3048	meters
gallons (U.S. liquid)	3.785412 E-03	cubic meters
mils	0.0254	millimeters
pounds (mass)	0.45359237	kilograms
square feet	0.09290304	square meters
yards	0.9144	meters

1 Introduction

1.1 Background

For years, traditional computer-aided design (CAD) products have had the capability of providing three-dimensional (3D) geometry and assigning attributes to rooms and equipment. The innovative aspect of Building Information Modeling (BIM) is that it creates a computable building description. The ability to use a single computable building description for multiple purposes — e.g., structural analysis, energy analysis, drawing production, clash detection — not only speeds project design and construction, it also improves the quality and coordination of the various analyses and documents produced.

In traditional practice, the drawings, or even the BIM, form one description of the building, the design specifications another, and the product data submitted during construction, a third. During design and construction, a great deal of time is spent by the project team coordinating and validating these multiple descriptions, both internally — coordination of drawings and schedules — and with each other.

During the operations and maintenance phase, facility personnel often create derivative documents to suit the needs of their particular responsibilities. As each group's activities lead to changes in the building configuration, these changes may be noted on the group's "local" documents but never transferred to those maintained by other groups. If a major renovation is required, a design consultant must first measure and inventory the building to create a new set of drawings reflecting all changes. There is constant activity searching for, validating, copying, reformatting, and recreating information.

In 2004, a report published by the National Institute of Standards and Technology (NIST) compared this scenario with one in which, "individuals and systems would be able to identify and access information seamlessly, as well as comprehend and integrate information across multiple systems" (Gallaher et al. 2004). The report defined this seamless interchange as "interoperability". The authors of the report quantified the value of capital facilities set in place in the United States in 2002 to be \$374 billion. They estimated that the 2002 cost of lack of interoperability was \$15.8 billion.

The fact that BIM technology creates computable, or machine-readable, building descriptions is not quite sufficient to achieve interoperability. In order for the building information to be interoperable, it must also conform to a common data model, or schema, that defines the class libraries — the object definitions, classifications, properties and usage. The value of a common data model cannot be overstated. Once the common class libraries are implemented, it becomes possible to automate the checking of a BIM for both its conformance to the data model and for its content.

A good case study is provided by the Southern Company, an Atlanta-based energy company serving the Southeast (Power 2012). Southern Company created a complete data-centric design strategy to ensure consistent and accurate asset information transmission from design through operations and maintenance. Central to this effort was the implementation of consistent class libraries across the entire organization.

The Southern Company automated data validation. For each project milestone, they established the fields of information required about each object type and were able to automate validation and rejection of nonconforming submissions. They were also able to report on variances, which was particularly useful late in projects when design changes can have major impact. This allowed the team to identify, for example, an equipment substitution that changed power requirements.

Finally, their solution understood relationships among data elements and was able to associate the data elements with other elements and with documents.

The Southern Company effort, which involved developing the class libraries and the data streams from authoring applications, as well as the data quality rules and variance reports, took five years and cost \$1.7 million. However, it is conservatively estimated to be saving over \$2 million per year per 100 employees in time spent in electronic document searches. It is important to note that Southern Company already had a document management system in place and that these savings result from greater precision in document searches resulting from both data normalization and the relationships between data elements. In addition, savings by the commissioning team of 45 persons are estimated to be \$2 million over 2 years, thanks to access to quality, normalized data.

Although the Southern Company's results are impressive, the 5 year, \$1.7 million effort cannot be replicated by many owners. However, similar results can be achieved through the adoption of open standards. In the United States, these standards are contained in the National BIM Standard – United StatesTM, or NBIMS (National Institute of Building Sciences 2012a).

For NBIMS, *Industry Foundation Classes (IFC) for Data Sharing in the Contruction and Facility-Management Industries* (ISO 16739:2013), provide a facility data model that is comprehensive, internationally recognized, and implemented in many of the software tools used in the capital facilities industry. This gives organizations the option of adopting, rather than inventing, a proven data model and model views. Open standards support not only internal processes, where the owner can customize the software, but also those that require data exchanges with outside partners.

Developing the "data streams" from BIM applications involves defining the information that must be passed from upstream activities to inform and enable downstream activities. These are called *exchange requirements*. A Model View Definition (MVD) formally defines a subset of the IFC entities and attributes that is needed to satisfy one or many exchange requirements. One such MVD, already developed, is the Facility Management Handover view (Espedokken 2012).

The Construction to Operations Building Information Exchange (East 2013), or COBie, is built upon the IFC Facility Management Handover MVD (East et al. 2013). COBie defines an incremental approach to capturing information about managed or maintained assets, such as space and equipment data, as it is created during design, construction, and commissioning. Designers provide floor space and equipment types. Contractors provide make, model, and serial numbers of installed equipment. COBiecompliant BIM authoring tools export the information in COBie format.

COBie also supports the association of data elements with "Zones" and "Systems." It supports the tracking of both issues and documents related to the elements, i.e., spaces and equipment.

COBie format data may be provided in three interoperable formats. The first two formats—the STEP Physical File Format and the ifcXML format—are based on the Industry Foundation Class model. The third format is a

SpreadsheetML. These formats were designed for software-to-software exchanges; although, the spreadsheet form of COBie has the benefit of allowing human interpretation and editing.

1.2 Objectives

The purpose of this project is to document the business case for standards-based interoperability. The COBie Calculator tool was developed to allow organizations to estimate their savings, based on their specific facility parameters and cost factors, if they were able to achieve such "interoperability" of space and equipment data—the two major categories of facility information that must be transferred from the project team to operations and maintenance. The savings derive from three basic innovations:

- 1. The ability to programmatically check the space and equipment data for completeness, conformance to data standards, and conformance to requirements. This improves the information quality and substantially reduces validation costs.
- 2. The substitution of electronic distribution, review processes, and approvals for paper-based processes in design and construction. This reduces copying, reformatting, and handling costs but does not address data quality or reduce rework.
- 3. The use of a standard, structured data format for moving space and equipment information through the project process and into facility management without data loss or need for data manipulation. This reduces searching, reformatting, and recreating costs.

1.3 Approach

COBie is designed to support an aggregation and flow of information from design systems to construction systems to facility-management systems, without any reformatting required.

In order for this information to flow "seamlessly," an automated workflow is required to transfer the COBie data based on certain trigger events. Many of these trigger events are approvals based on a review. Such reviews occur multiple times during the planning, design, and construction of a facility. The ability to automate the checking of a COBie file for content and completeness further exploits the interoperability of the data to reduce costs in these highly iterative work processes.

Software products exist for workflow automation and for automated checking of structured data, such as a COBie file. There are also BIM authoring products that export COBie data and facility management systems that import it. The purpose of the COBie Calculator is to quantify the potential for cost savings in a scenario of true interoperability.

Only the costs associated with the documentation, specification, and fulfillment of managed asset requirements (space and maintained equipment) are considered in this Calculator. However, the methodology used in developing the COBie Calculator could be readily applied to estimate cost savings associated with other types of standards-based information exchanges throughout the facility life cycle.

1.3.1 How savings are achieved

Chapter 2 describes the facility life cycle processes and current methodology for the contracted exchanges required (East and Nisbet 2012). During these processes, there are activities that add value: updating facility standards to align with new technology, studying design options to determine the best and most cost-effective solution, researching building products to develop a high-performance specification, and so forth. However, these activities are often accompanied by many non-value-added tasks, such as reformatting documents, converting digital information to a different file format, copying paper documents, creating and logging transmittals, mailing hard copies, and transferring review comments to multiple document copies, to name a few. Another group of necessary but non-value-added activities involves the detection of errors after the fact. This very timeconsuming checking takes place primarily during design and submittal reviews. To streamline the facility life cycle processes, the goal is not to reduce the time or funding allocated to value-added activities, but to eliminate or minimize the time and costs associated with non-value-added ones.

Chapter 3 explores the potential for process improvement upon implementing the three basic innovations described above:

- 1. automated checking
- 2. elimination of paper and the use of a managed collaboration system
- 3. the use of COBie for moving space and equipment information through the project process and into facility management.

Cost variables are assigned to each life-cycle process tasks that could be eliminated, automated, or streamlined through the use of COBie in conjunction with a managed collaboration system. "Current" values for these cost variables are then estimated based on a paper-based life cycle process.

Chapter 4 applies new values to the cost variables identified in Chapter 3, based on the future, improved life-cycle processes. These improvements lead to complete elimination of some tasks, automation of other tasks, and streamlining of additional tasks, thus reducing non-value added efforts and expenses, errors, and process cycle times. The resulting opportunities for savings can be classified as follows:

- 1. VALIDATION savings from the ability to programmatically check the space and equipment data
- 2. COPYING savings from reliance on electronic documents and data as the project record
- HANDLING savings from the adoption of managed project collaboration and management systems
- 4. SEARCHING savings from the ability to electronically compare information
- 5. REFORMATTING savings from adoption of a single, open standard data format for information relating to managed assets
- 6. RECREATING savings from the use of a standard, structured data format for moving space and equipment information through the project process and into facility management.

The technology components exist today to achieve savings in all of these areas. Many organizations are already using managed electronic collaboration systems and loading contractor-provided data into their facility management systems. The COBie Calculator is designed to allow organizations to estimate their potential savings on a very granular level. Users of the Calculator can choose to remove Current Process costs that have already been eliminated and to pursue all or some potential savings areas.

Chapter 5 describes the COBie Calculator and how to use it. An overview of the Calculator's layout is provided as well as a detailed description of the information contained in each tab. Some of the tabs require the user to input data. Other tabs display the Calculator's results. Users of the Calculator should not attempt to alter the data these tabs. An example is also presented to illustrate how the Calculator works.

Chapter 6 provides example project analyses, and Chapter 7 explores the relative importance of the various cost variables on the final outcome.

Chapter 8 provides an example building program analysis.

1.3.2 Industry-wide implementation

The ultimate vision is that the capital facilities industry as a whole will transition to the use of standard structured data instead of paper or epaper documents. Changes needed to support this transition include the following:

- Software vendors serving the capital facilities industry must provide comprehensive support of computable building descriptions in standard formats, including both import and export capabilities.
- Manufacturers must provide a standard set of information about each product type in a standard format.
- Authorities Having Jurisdiction (AHJ), such as code officials, must accept electronic documents, signatures, and professional stamps.
- Owners must adjust their contract terms, deliverable requirements and review processes to maximize the technology-driven savings.
- Designers and Contractors must develop the technical capabilities to provide these highly structured electronic deliverables and like owners adjust their work processes to take advantage of the potential savings.

2 Current LCie Process Descriptions

2.1 Prior Research

A number of published and unpublished studies have contributed to an understanding of current life cycle processes in the capital facilities industry, the tasks involved in each process, the actors performing the tasks, and the cost factors associated with the tasks, as well as opportunities for cost savings and reduced execution times through use of structured information exchanges such as COBie.

The paper titled *A Life-Cycle Model for Contracted Information Exchange* (East et al. 2010) discussed transforming paper-based deliverables into usable building information by eliminating current, document-centric information exchanges and utilizing more efficient COBie based exchanges. The report also emphasized that since contracting procedures are not changed, the COBie based life cycle model provides a cost effective method for delivering as-built and as-maintained BIM data.

In the article titled *Value-added Analysis of the Construction Submittal Process* (East and Love 2011) three main information exchanges were identified and analyzed based on the value-added methodology proposed by William Trischler (1996). By assigning tasks to the most common project delivery methods and reviewing those tasks based on time required to complete, the authors of the report were able to demonstrate a clear time savings by eliminating the non-value added tasks from a process. Such approaches are beginning to be applied in construction planning such as Lean Construction.

The paper titled, *Analysis of Life-Cycle Information Exchange* (East and Nisbet 2010) provided a cost model within an application called the COBie2 Calculator that allowed the cost of traditional information exchanges to be compared against those utilizing open data standards. Data from a medical clinic that was completed around the time of the report was utilized to compare the potential savings associated with moving from a document centric information exchange to one utilizing a COBie workflow.

2.2 Authoritative sources for current life cycle processes

Current design and construction processes are well-defined in the capital facilities industry. The business process diagram in Appendix A shows the overall life cycle process. Many of the data exchanges are stipulated in legally binding documents, such as contracts and project specifications. Predesign and post-construction activities are more organization-specific. In the case of the Department of Defense (DoD), there are standard procedures for planning and project definition. Post-construction, facility operations and management activities are less standardized.

Three military departments are contained within the Department of Defense: The Department of the Army, the Department of the Navy, and the Department of the Air Force. Buildings associated with these three departments amount to over 545,700 throughout the United States and world (Department of Defense 2008). Each of these departments utilizes both Unified Facilities Criteria (UFC) and Unified Facilities Guide Specifications (UFGS) as the basis for developing projects from planning through construction. These specific guides are discussed below and compared to the industry standard documents that define facility life cycle project requirements outside of the government realm.

Facility life cycle processes described below are derived from 4 major sources:

- AIA B101-2007 Published by the American Institute of Architects (AIA), B101 is the flagship 2007 owner-architect agreement upon which other AIA standard owner-architect agreements are based. B101 describes and explains the traditional architectural design services to be provided on a project. Five design phases are defined: Schematic Design, Design Development, Construction Documents, Bidding or Negotiation, and Construction Administration, and deliverables are associated with each phase. Since this AIA document's use is intended for a wide range of clients and project types, deliverable requirements are not highly specific.
- **CSI MasterFormat** Construction Specifications Institute's (CSI) MasterFormat (2004) is the widely accepted standard for organizing project specifications during design for post-design phase activities. Specifically, specification section 01 33 00 Submittal Procedures provides direction regarding what submittals and how many copies of each are required during the pre-construction phase of the project.

- Unified Facilities Criteria (UFC) Unified Facilities Criteria (UFC) (National Institute of Building Sciences 2012b) documents provide planning, design, construction, sustainment, restoration, and modernization criteria, and apply to the military departments, the defense agencies, and the DoD field activities. In contrast to the AIA B101 document, these documents provide specific design criteria for several building types. Submission requirements for each design milestone are also provided.
- Unified Facilities Guide Specifications (UFGS) Unified Facilities Guide Specifications (UFGS) (NIBS 2012c) are a joint effort of the U.S. Army Corps of Engineers (USACE), the Naval Facilities Engineering Command (NAVFAC), the Air Force Civil Engineer Support Agency (HQ AFCESA), the Air Force Center for Engineering and the Environment (HQ AFCEE) and the National Aeronautics and Space Administration (NASA). UFGS are for use in specifying construction for the military services. UFGS is very closely based on CSI MasterFormat specifications. Regarding the submittal procedures section, the section names and numbers for both UFGS and MasterFormat are identical; however, submittal requirements vary based on the government's specific needs.

For a side by side comparison of AIA/CSI requirements versus UFC/UFGS submission requirements, refer to the chart provided in Appendix B. This chart outlines the standard submittals for each project phase from predesign through operations and maintenance.

2.3 Modes of information exchange in current processes

2.3.1 Document-Centric, Paper-Based, Physical Exchange

This paper-based method requires manually copying and handling paper documents—reproducing, sorting, filing, logging and shipping. Typically, numerous copies of each required submission must be distributed to team members in order to meet contractual requirements. Currently, UFC documents indicate there are four design phase submissions. Although electronic deliverables are noted in the guidelines, hard copies are typically requested by the reviewing parties. The Current Process documented in this report assumes 6 copies for each submission.

Cost factors associated with this exchange include both labor and out-ofpocket costs related to copying and handling these documents. In addition, the physical handling and delivery time means there is a delay in making information available to the intended recipients. This type of exchange is considered the baseline, or "Current Process."

2.3.2 Document-Centric, File-Based, E-mail Exchange

The file-based e-mail method of exchange eliminates the physical paper from the initial distribution process, but does not remove the labor associated with manually sorting, filing and logging the electronic documents. Although information is being sent electronically, it still requires logging of the exchange by both the initiating party and the recipient. Although electronic copies are transmitted, documents are often printed for review. Mailing costs are eliminated with this process, but printing and reproduction costs are often shifted from the sender to the recipient. Sorting, filing and logging tasks are still necessary.

2.3.3 Document-Centric, File-Based, Managed Exchange

This method provides a managed data exchange by an electronic collaboration system, accessible to both the sender and the recipient that automates the clerical steps of filing and logging. The data managed are electronic documents.

This type of exchange reduces both costs and lag time. Delivery costs are eliminated since all information is transferred electronically. Although documents must be uploaded to the system and directed to intended recipients, transmitting and logging the documents is automated, with resulting labor savings. User actions (forward, view, approve, and so forth) are automatically recorded and instantly visible to authorized team members. A single, authoritative version of all project documents is stored in one location for everyone's use/review throughout the project duration. Nevertheless, the electronic documents are typically printed to perform reviews.

This approach is compared to both the baseline Current Process and the Expected Process in Chapter 6.

2.4 Current life cycle processes

The processes discussed below provide information on how projects are typically completed from inception through construction. Each process contains an information exchange, which is a deliverable that must be completed. Each of the processes below is based on UFC and UFGS requirements.

Although current UFC requirements state that deliverables during the Design life cycle processes are to be submitted electronically, project managers report that paper deliverables are also required in order to complete the review process. Therefore, the Current Processes described below assume paper deliverables. The diagrams in Appendix C detail the discreet tasks and information exchanges required to complete each process and highlight potential opportunities for savings, which will be further discussed in Chapter 4.

2.4.1 Study and define needs

Life Cycle Process:	Study and Define Needs
Diagram:	Figure 18 in Appendix C
Actor(s):	Owner
Description:	Standard facility information must be available in order to determine the basic requirements for a potential project. The Owner identifies the need and either develops technical criteria for the facility if none exist or utilizes existing technical criteria if available. If it does exist, this information must be checked for relevancy every five years to remain consistent with overall needs.
Information Content:	Facility Program
Contracted Exchange/Deliverable:	Facility Criteria

2.4.2 Develop design criteria

Life Cycle Process:	Develop Design Criteria
Diagram:	Figure 19 in Appendix C
Actor(s):	Owner
Description:	Specification information for equipment based on facility criteria is generated early in the planning process by the Owner. This information must be checked for relevancy every five years to remain consistent with overall needs.
Information Content:	Type DataProduct Data
Contracted Exchange/Deliverable:	Discipline Specification

2.4.3 Study technical feasibility

Life Cycle Process:	Study Technical Feasibility
Diagram:	Figure 20 in Appendix C
Actor(s):	Owner and Architect or Planner
Description:	The <i>Feasibility Study</i> allows the Owner to evaluate different options (typically three) based on the identified requirements before finalizing specific information about a project. The Architect or Planner develops the study based on the information contained in the Facility Criteria and Discipline Specification information exchanges.
Information Content:	Feasibility Study Options
Contracted Exchange/Deliverable:	Feasibility Study

2.4.4 Communicate results decisions

Life Cycle Process:	Communicate Results Decisions
Diagram:	Figure 21 in Appendix C
Actor(s):	Owner
Description:	Initial criteria about a project must be established in order to evaluate the project feasibility. The Owner evaluates the Facility Criteria, Discipline Specifications, and Feasibility Study to determine whether or not to move forward with the project.
Information Content:	 Detailed Project Scope Preliminary Budgetary Cost Information Site Location & Approval Economic Analysis Facility Planning Data
Contracted Ex- change/Deliverable:	Project Definition

2.4.5 Develop program – space program

Life Cycle Process:	Develop Program – Space Program
Diagram:	Figure 22 in Appendix C
Actor(s):	Owner's Representative and Architect or Planner
Description:	Once the Project Definition has been established and approved, further development of the project requirements can occur. The Architect or Planner evaluates information contained in the Project Definition information exchange to identify space needs based on the facility type. Space requirements, based on facility type, are located online in electronic document format and must be downloaded. These documents are typically printed by the end user. If no standard facility space criteria exist, it must be created by referencing similar facility types.
Information Content:	■ Facility Space Requirements
Contracted Exchange/Deliverable:	Space Program

2.4.6 Develop program – product program

Life Cycle Process:	Develop Program – Product Program
Diagram:	Figure 23 in Appendix C
Actor(s):	Owner's Representative and Architect or Planner
Description:	The Architect or Planner evaluates information contained in the Project Definition information exchange to identify product needs based on the facility type. Requirements for products based on facility type are located online in electronic document format and must be downloaded. These documents are typically printed by the end user. If no standard facility product criteria exist, it must be created by referencing similar facility types.
Information Content:	 Facility Product Requirements
Contracted Exchange/Deliverable:	Product Program

2.4.7 Prepare invitation to bid and receive proposals (pre-design)

Life Cycle Process:	Prepare Invitation to Bid and Receive Proposals (Pre-Design)
Diagram:	in Appendix C
Actor(s):	Owner's Representative and Architect
Description:	Once the major criteria have been determined, the Owner's Representative prepares and distributes a Request for Proposal (RFP).
Information Content:	Project DefinitionSpace ProgramProduct Program
Contracted Exchange/Deliverable:	Request for Proposal (RFP)

2.4.8 Explore concepts – design early

Life Cycle Process:	Explore Concepts – Design Early
Diagram:	Figure 25 in Appendix C
Actor(s):	Owner's Representative, Architect and Consultants
Description:	The Architect utilizes the specific information produced during pre-design to develop a solution that reflects the requirements stated in the Project Definition, Space Program, and Product Program. Currently, the owner requires 6 hard copies to be submitted for each review cycle. The Architect performs a QA/QC check before submitting to the Owner's Representative. After receiving the submission, the Owner's Representative validates the documents (reviews) and provides comments to the Architect. The Architect and Consultants are then required to update the documents based on the comments. After revisions are made, the Architect resubmits.
Information Content:	Concept Design DrawingsCost EstimateCalculations
Contracted Exchange/Deliverable:	Design Early

2.4.9 Develop design – design schematic

Life Cycle Process:	Develop Design – Design Schematic
Diagram:	Figure 26 in Appendix C
Actor(s):	Owner's Representative, Architect and Consultants
Description:	The Architect further develops the approved Design Early deliverable documents to produce the Design Schematic documents. Currently, the owner requires 6 hard copies to be submitted for each review cycle. The Architect performs a QA/QC check before submitting to the Owner's Representative. After receiving the submission, the Owner's Representative validates the documents and provides comments to the Architect. The Architect and Consultants are then required to update the documents based on the comments. After revisions are made, the Architect resubmits.
Information Content:	 Basis of Design Narrative Design Schematic Drawings Energy Analysis Life Cycle Cost Analysis Cost Estimate Geotechnical Report Calculations Environmental Report
Contracted Ex- change/Deliverable:	Design Schematic

2.4.10 Develop design – product type template, product type candidate

Life Cycle Process:	Develop Design – Product Type Template, Product Template
Diagram:	Figure 26 in Appendix C
Actor(s):	Specifier
Description:	As the design progresses, performance characteristics and suitable products for the building systems are identified. System types and equipment are identified by the Specifier based on the facility requirements. Six copies are required to be submit-

	ted for review. Some products are defined in more detail by identifying manufacturers and model numbers which meet requirements (Basis of Design). In these cases, 3 qualifying products should be listed.
Information Content:	 Outline Specifications
Contracted Exchange/Deliverable:	Product Type Template

2.4.11 Develop design – design coordinated

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Life Cycle Process:	Develop Design – Design Coordinated
Diagram:	Figure 27 in Appendix C
Actor(s):	Owner's Representative, Architect and Consultants
Description:	The Architect further develops the approved Design Schematic deliverable documents to produce the Design Coordinated documents. In addition, the building systems are coordinated to eliminate spatial interferences. This is the major coordination submittal before the final delivery package. The owner requires 6 hard copies to be submitted for each review cycle. Due to the higher level of coordination and increase in number of interested reviewing parties, more copies are sometimes needed. The Architect performs a QA/QC check before submitting to the Owner's Representative. After receiving the submission, the Owner's Representative validates the documents and provides comments to the Architect. The Architect and Consultants are then required to update the documents based on the comments. After revisions are made, the Architect resubmits.
Information Content:	 Basis of Design Narrative Design Coordinated Drawings Energy Analysis Life Cycle cost Analysis
	 Cost Estimate Geotechnical Report
	 Calculations

	Environmental ReportProject Information Form
Contracted Ex-	Design Coordinated
change/Deliverable:	

2.4.12 Develop design – product type candidate

Life Cycle Process:	Develop Design – Product Type Candidate
Diagram:	Figure 27 in Appendix C
Actor(s):	Specifier
Description:	The performance requirements of building systems and equipment are further refined and documented by the Specifier during this phase. Any equipment, products, or systems not selected previously are identified. Specific manufacturers and model numbers are noted. Three qualifying products are identified. Six copies are submitted for each review cycle.
Information Content:	SpecificationsSubmittal Register
Contracted Exchange/Deliverable:	Product Type Candidate

2.4.13 Finalize design – design final

Life Cycle Process:	Finalize Design – Design Final
Diagram:	Figure 28 in Appendix C
Actor(s):	Owner's Representative, Architect and Consultants
Description:	The Design Final package is the final set of contract documents ready for bid solicitation by the Owner. This final design deliverable does not require another review by the Owner's Representative.
Information Content:	 Basis of Design Narrative Design Final Drawings Energy Analysis Life Cycle cost Analysis Cost Estimate

	 Geotechnical Report Calculations Environmental Report Project Information Form Quality Control Data Color Documentation Binder Code Compliance Certification
Contracted Exchange/Deliverable:	Design Final

2.4.14 Finalize design – product type candidate

Life Cycle Process:	Finalize Design – Product Type Candidate
Diagram:	Figure 28 in Appendix C
Actor(s):	Specifier
Description:	At this phase of the project all equipment and system types must be identified by the Specifier. Product information from the Design Coordinated phase is incorporated into to this phase. Three (3) qualifying products for each type required must be listed.
Information Content:	SpecificationsSubmittal Register
Contracted Exchange/Deliverable:	Product Type Candidate

2.4.15 Prepare invitation to bid and receive proposals (post-design)

Life Cycle Process:	Prepare Invitation to Bid and Receive Proposals (Post-Design)
Diagram:	Figure 29 in Appendix C
Actor(s):	Owner's Representative
Description:	Once the design is complete, the Owner packages the Design Final Documents information together with other owner-supplied information (e.g., contractual terms) and creates a <i>Request for Proposals (RFP)</i> Package. This becomes the official bid set.

Information Content:	Final Design DocumentsSpecifications
Contracted Exchange/Deliverable:	Request for Proposal (RFP)

2.4.16 Respond to pre-proposal inquiries

Life Cycle Process:	Respond to Pre-Proposal Inquiries
Diagram:	Figure 30 in Appendix C
Actor(s):	Owner's Representative, Architect and Contractor
Description:	Before finalizing a bid proposal, the Contractor typically requests additional information or clarifi- cation of some bid documents.
Information Content:	 Clarification Request
Contracted Exchange/Deliverable:	Inquiry Issue (Clarification)

2.4.17 Develop pre-construction plan

Life Cycle Process:	Develop Pre-Construction Plan
Diagram:	Figure 31 in AppendixC
Actor(s):	Contractor
Description:	The Contractor is required to develop a Pre- Construction Plan that describes how the Contrac- tor will make provisions for managing the con- struction of the facility. This is sent as a submittal package. Refer to the Submittal Package exchange for detailed requirements related to transmitting and handling Pre-Construction Plan submittals.
Information Content:	 Equipment Lists Certificates of Insurance Surety Bonds List of Proposed Subcontractors List of Proposed Producers Construction Progress Schedule Network Analysis Schedule Submittal Register Schedule of Prices Health and Safety Plans

	Work PlanQuality Control planEnvironmental Protection Plan
Contracted Exchange/Deliverable:	Pre-Construction Plan

2.4.18 Identify discrepancies

Life Cycle Process:	Identify Discrepancies
Diagram:	Figure 32 in Appendix C
Actor(s):	Owner's Representative, Architect and Contractor
Description:	The Contractor submits a Request for Information (RFI) to ask for clarification during the construction process. These questions may be due to but not restricted to ambiguities or contradictions in the drawings or to site conditions.
Information Content:	 Request for Information
Contracted Exchange/Deliverable:	Inquiry Issue (RFI)

2.4.19 Prepare submittal information – product type selection

Life Cycle Process:	Prepare Submittal Information - Product Type Selection
Diagram:	Figure 33 in Appendix C
Actor(s):	Contractor, Sub-Contractors
Description:	The Contractor and Sub-Contractors gather information for products identified in the Design Final documents and prepare submittals. Refer to the Submittal Package exchange for detailed requirements related to transmitting and handling Product Type Selection submittals.
Information Content:	 Product Data Samples Design Data Test Reports Certificates Manufacturer's Instructions Manufacturer's Field Reports

	 Operations and Maintenance Data
Contracted Ex-	Product Type Selection
change/Deliverable:	

2.4.20 Prepare submittal information – system layout

Life Cycle Process:	Prepare Submittal Information - System Layout
Diagram:	Figure 34 in Appendix C
Actor(s):	Contractor, Sub-Contractors
Description:	The Contractor and Sub-Contractors review information for products identified in the Design Final documents and prepare shop drawings. Refer to the Submittal Package exchange for detailed requirements related to transmitting and handling System Layout submittals.
Information Content:	Shop Drawings
Contracted Exchange/Deliverable:	System Layout

2.4.21 Organize submittal information

Life Cycle Process:	Organize Submittal Information
Diagram:	Figure 35 in Appendix C
Actor(s):	Owner's Representative, Architect and Contractor
Description:	The Contractor organizes the required submittal information and creates Submittal Packages to be reviewed by the Owner's Representative and/or Architect. Six hard copies are required to be submitted for review.
Information Content:	 Pre-Construction Plan Product Type Selection System Layout (Refer to the Information Content for each of these individual items for a complete list of included information.)
Contracted Ex- change/Deliverable:	Submittal Package

2.4.22 Perform submittal review – submittal issue

Life Cycle Process:	Perform Submittal Review
Diagram:	Figure 36 in Appendix C
Actor(s):	Architect, Consultants and Contractor
Description:	The Architect and/or Sub-Consultants validate the submittals provided by the Contractor and provide comments. Six hard copies are required.
Information Content:	Marked-Up Submittal PackageSubmittal Review Comments
Contracted Exchange/Deliverable:	Submittal Issue

2.4.23 Provide resources

Life Cycle Process:	Provide Resources
Diagram:	Figure 37 in Appendix C
Actor(s):	Contractor
Description:	The Contractor contacts a Supplier to order equipment and materials. The Supplier then provides a price quote to the Contractor for the equipment and/or materials. The Contractor verifies the specifications of the equipment and/or materials in the quote against approved submittal documentation and then submits them to the Owner's Representative and/or Architect for approval.
Information Content:	Purchase Order
Contracted Exchange/Deliverable:	Purchase Order

2.4.24 Execute construction activities

Life Cycle Process:	Execute Construction Activities
Diagram:	Figure 38 in Appendix C
Actor(s):	Contractor

Description: Information Content:	The Contractor installs the building equipment, materials, and systems using the design final drawings, approved shop drawings, product data, and manufacturer's instructions. Design Final Drawings and Product Type Candidate Approved Shop Drawings Manufacturer's Instructions
Contracted Exchange/Deliverable:	Product Installation

2.4.25 Perform equipment testing

Life Cycle Process:	Perform Equipment Testing
Diagram:	Figure 39 in Appendix C
Actor(s):	Contractor
Description:	After the Contractor completes the installation process, the equipment/systems must be tested by activating the equipment. This testing must be completed with the Owner's Representative and Manufacturer's representative present.
Information Content:	 Equipment Start-Up Test Results
Contracted Exchange/Deliverable:	Equipment Start-Up Report

2.4.26 Inspect and approve work

Life Cycle Process:	Inspect and Approve Work
Diagram:	Figure 40 in Appendix C
Actor(s):	Architect and Contractor
Description:	When the Contractor has completed installation of equipment or systems, a notification is sent to the Architect indicating the installed item is ready for inspection/observation. The Architect conducts regular inspections of the installed construction work. The findings of the inspections including any deficiencies with the installation of the con-

	struction work are documented in a report. If defi- ciencies are identified in the inspection report, the Contractor corrects them and then requests a re- inspection.
Information Content:	 Observation Field Report
Contracted Exchange/Deliverable:	Product Inspection

2.4.27 Define, record and certify discrepancies

Life Cycle Process:	Define, Record and Certify Discrepancies
Diagram:	Figure 41 in Appendix C
Actor(s):	Architect and Contractor
Description:	The Architect creates a final punchlist based upon a survey of the completed construction work. The Contractor corrects the deficiencies identified in the punchlist. The Architect verifies that the Contractor has corrected the deficiencies in the punchlist by performing a final walkthrough.
Information Content:	 All Issues Observed from Previous Product Inspections Final Walkthrough Observation Field Report
Contracted Exchange/Deliverable:	Punchlist Issue

2.4.28 Closeout

Life Cycle Process:	Closeout
Diagram:	
	in Appendix C
Actor(s):	Owner and Contractor
Description:	The Contractor gathers all as-built information re-
	lated to the project and forwards the information
	to the Owner. Four copies are typically required.
Information Content:	 Operations and Maintenance Manuals Record of Designated Equipment and Materials Data Files

	 Commissioning Report Record Specifications Record (As-Built) Drawings Final Approved Shop Drawings
Contracted Exchange/Deliverable:	Turnover Package

3 COBie Calculator Cost Model

Each of the life cycle processes discussed in Chapter 2 can be further divided into tasks. As mentioned in Chapter 1, each task can be classified as a value-added task or a non-value-added task. In reducing the costs of the facility life cycle processes, the goal is not to reduce the time or funding allocated to value-added tasks, but to eliminate or minimize the time and costs associated with non-value-added ones.

To do this, cost variables are assigned to tasks that could be eliminated, automated, or streamlined through the use of COBie in conjunction with a managed collaboration system. For example, the Design Final process has a task called Send Final Documents. This task has cost variables associated with the number of transmittals, the mailing cost per transmittal, the time needed to prepare a transmittal, and the Architect Drafter's hourly rate. The Calculator also associates a Review Cycle variable with tasks that can be eliminated, automated or streamlined where applicable. For example, the Design Early process associates this variable with the tasks that come subsequently after the Architect logs receipt of the Owner/Owners Representative comments.

In the Calculator, costs were only applied to the Owner and parties that have a direct contractual agreement with the Owner. Additional savings will accrue in the next layer of relationships (e.g. sub-contractors); however, these are not addressed in this version of the Calculator. For example, subcontractors and designers must identify products that meet specifications.. They would accrue similar savings in this process, but these savings are not included in the Calculator.

Only tasks that benefit from either the use of standard, structured data about managed assets and/or complete reliance on electronic documentation and communication have been considered in the COBie Calculator.

3.1 Major cost categories

Over 200 process specific variables are identified in the COBie Calculator. These variables can be grouped into several major cost categories:

- *Number of Pages:* Costs related to the number of pages in a document-drawings, specifications, submittals, etc.
- *Number of Sets:* Costs associated with the number of required sets of a document.
- Number of Objects: Costs related to the number of spaces and equipment.
- *Labor Rates:* Rates for the different project team members. These rates can be direct or marked up.
- *Time:* Costs related to the time needed to perform an action: logging, preparing, documenting, organizing, searching, etc.
- *Mailing:* Costs associated with mailing, messengering, or otherwise delivering documents from one project team member to another.

3.1.1 Owner specific costs

Some of the cost variables are specific to the owner. These variables, regardless of the exchange or project, are consistent. The owner specific costs are:

- Avg. Number of Pages in Facility Criteria
- Avg. Number of Pages in Discipline Specification
- Avg. Number of Pages in Project Definition
- Avg. Number of Pages in Front Matter

3.1.2 Project specific costs

There are some costs that are specific to the project, regardless of the exchange or project team members involved. These are:

- Number of Unique Product Types
- Number of Tagged Components (Pieces of Equipment)
- Number of Space Types per Building
- Time to Log

3.1.3 Process specific costs

The remaining cost variables are specific to each LCie process. A list of the applicable variables for each LCie process can be found in the tables of the Contracted Exchanges (Deliverables) and How Savings Occur section in Chapter 4.

While some of the variables may have the same name as others, the value of the variable changes based on the exchange and project team members involved. For example, the average number of transmittals required to send the final design documents from the Architect to the Owner's Representative in the Design Final exchange is different than the average number of transmittals required to send the RFP package from the Owner's Representative to the Contractor in the Request for Proposal exchange, even though the cost variable to capture the number of transmittals in both of these cases is called Avg. Number of Transmittals.

Because of this, the Calculator requires input for 210 process specific variables. The definitions for all of the variables, as well as their estimated values for the current paper-based LCie processes, can be found in Appendix E. Appendix F shows all the tabs of the Calculator. The Current Assumption tab shows the LCie number of the processes (under the Tab Reference column) in which a variable is used.

Not all actors are involved in every process. For example the Contractor is not active during the Design Schematic process. Refer to the LCie diagrams in Appendix C to understand which processes and therefore which process variables are relevant to each role.

4 Expected LCie Processes

The Expected Process is a scenario of full standards based interoperability where:

- All building information modeling tools used in design and construction both import and export COBie data
- The systems used in facility/maintenance management import and export COBie data
- Project communications and information turnover at closeout are handled in a project collaboration system with automated workflow
- Software tools are available to check the COBie data for conformance to
 the specification and for completeness, and also to compare the contents of two COBie files: one file that specifies the space and equipment
 requirements and the other that describes the project team-proposed
 spatial configuration and manufacturer product specifications

4.1 Opportunities for savings

As previously mentioned in Chapter 1, the opportunities for savings can be classified as follows:

- 1. VALIDATION savings from the ability to programmatically check the space and equipment data for completeness, conformance to standards and conformance to requirements.
- 2. COPYING savings from reliance on electronic documents and data as the project record.
- HANDLING savings from the adoption of managed project collaboration and management systems for transmittal and automated logging of project documents.
- 4. SEARCHING savings from the ability to electronically compare product data to product specifications.
- 5. REFORMATTING savings from adoption of a single, open standard data format for information relating to managed assets.
- 6. RECREATING savings from the use of a standard, structured data format for moving space and equipment information through the project process and into facility management, eliminating the need for data re-entry. In addition, rework is a form of recreation.

Savings can be achieved in non-value added tasks to different degrees. Some tasks can be completely eliminated, while others can be automated or streamlined. An appropriate "Reduction Factor" is applied to each variable discussed in Chapter 3 whose costs can be reduced by using an electronic collaboration system and/or a structured data format. This reduction factor is a percent reduction of a variable's "Current" Process value, resulting in a variable's "Expected" Process value.

The estimated variable values for the Expected LCie Processes can be found in Appendix E. The process diagrams in Appendix C indicate which tasks are expected to be eliminated, automated, and streamlined. Appendix D groups the tasks into one of three categories (eliminated, automated, or streamlined) and describes the assumptions used to justify that categorization.

Of the 25 life cycle processes studied, 19 (76%) would obtain a savings from the expected approach, these include:

- Facility Criteria
- Discipline Specification
- Feasibility Study
- Project Definition
- Space Program
- Product Program
- Request for Proposal
- Design Early
- Design Schematic
- Design Coordinated
- Design Final
- · Request for Proposal
- Inquiry Issue
- Inquiry Issue (RFI)
- Submittal Package
- Submittal Issue
- Product Installation
- Product Inspection
- Turnover Package

The six processes that do not obtain savings are:

- Develop Pre-Construction Plan
- Prepare Submittal Information- Product Type Selection
- Prepare Submittal Information- System Layout
- Provide Resources
- Perform Equipment Testing
- Define, Record and Certify Discrepancies

For completeness purposes, these processes are included in the following section; however, their potential savings is listed as "None" and they do not have any process specific variables.

Although the Calculator only computes savings to the Owner/Owner's Representative, Architect, and Contractor, other parties who will benefit from the Expected Process are included in the tables below.

4.2 Contracted exchanges (deliverables) and how savings occur

4.2.1 Study and define needs

Contracted Exchange/Deliverable:	010 Facility Criteria
Diagram:	Figure 18 in Appendix C
Beneficiaries:	Owner
Information Content:	Facility Program
Potential Savings:	Copying: Reproduction savings from reliance on electronic documents and the elimination of paper
Process Specific Variables:	 O10.02.40 Copy Facility Criteria Avg. Number of Pages in Facility Criteria Avg. Number of Sets Required Avg. In-house Reproduction Time per Set

4.2.2 Develop design criteria

Contracted Ex-	020 Discipline Specification
change/Deliverable:	
Diagram:	Figure 19 in Appendix C
Beneficiaries:	Owner

Information Content:	Type DataProduct Data
Potential Savings:	Copying: Reproduction savings from reliance on electronic documents and the elimination of paper
Process Specific Variables:	 O20.02.40 Copy Discipline Specification Avg. Number of Pages in Discipline Specification Avg. Number of Sets Required Avg. In-house Reproduction Time per Set

4.2.3 Study technical feasibility

Contracted Ex- change/Deliverable:	030 Feasibility Study
Diagram:	Figure 20 in Appendix C
Beneficiaries:	Owner and Architect or Planner
Information Content:	 Feasibility Study Options
Potential Savings:	Copying: Reproduction savings from reliance on electronic documents and the elimination of paper Handling: Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. Managed electronic collaboration systems will notify intended recipients when edocuments are released and automatically log both the issuing and viewing of those documents.

Process Specific Variables:

030.04 Copy Feasibility Study and 030.14 Copy Revised Feasibility Study

- Avg. Number of Options
- Avg. Number of Sheets per Option
- Avg. Number of Letter-Sized Pages in Design Narrative per Option
- Avg. Number of Pre-Design Submittal Sets Required
- Avg. In-house Reproduction Time per Set

030.05 Send Feasibility Study and 030.15 Send Revised Feasibility Study

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

030.06 Log Transmittal Feasibility Study and 030.16 Log Transmittal of Revised Feasibility Study

- Avg. Number of Transmittals
- Time to Log

030.08 Log Receipt Feasibility Study

- Avg. Number of Transmittals
- Time to Log

030.10.20 Send Comments to Planner

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

030.10.21 Log Transmittal of Feasibility Study Comments

- Avg. Number of Transmittals
- Time to Log

030.12 Log Receipt of Review Comments

- Avg. Number of Transmittals
- Time to Log

4.2.4 Communicate results decision

Contracted Ex-	040 Project Definition
Contracted Lx	040 Troject Definition

change/Deliverable:	
Diagram:	Figure 21 in Appendix C
Beneficiaries:	Owner
Information Content:	 Detailed Project Scope Preliminary Budgetary Cost Information Site Location & Approval Economic Analysis Facility Planning Data
Potential Savings:	Copying: Reproduction savings from reliance on electronic documents and the elimination of paper
Process Specific Variables:	 O40.03.30 Copy Project Definition Avg. Number of Pages in Project Definition Avg. Number of Sets Required Avg. In-house Reproduction Time per Set

4.2.5 Develop program – space program

Contracted Ex- change/Deliverable:	050 Space Program
Diagram:	Figure 22 in Appendix C
Beneficiaries:	Owner's Representative and Architect or Planner
Information Content:	 Facility space requirements
Potential Savings:	 Design professionals typically re-enter the Owner's space requirements into the system they use for space programming. COBieformatted data permits data to be transferred directly from the Owner to the Architect or Planner's system Reformatting: Requirements associated with each space are typically gathered and then documented on Room Data Sheets. COBie format would either eliminate the need to produce room data sheets or support automation of their production

Validating:

- The Architect/Planner sends the Space Program to the Owner's Representative for review. Currently, this is done by comparing 2 documents. Use of COBie format would permit automated checking.
- If the Architect/Planner could automate checking of his work product against the Owner's requirements, then a rework/rereview cycle could be eliminated.

Copying:

Reproduction savings from reliance on electronic documents and the elimination of paper

Handling:

Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense.
 Managed electronic collaboration systems will notify intended recipients when edocuments are released and automatically log both the issuing and viewing of those documents

Process Specific Variables:

050.03 Search for Space Program Criteria as Necessary

- Number of Space Types per Building
- Avg. Time Spent Searching for Space Program Criteria

050.04 Reformat Space Program Criteria into Room Data Sheets

 Number of Space Types per Building Avg. Time Spent Reformatting Space Program Criteria into Room Data Sheets

050.05 Send Copies of Space Program

- Avg. Number of Pages in Space Program
- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Number of Pre-Design Submittal Sets Required

Avg. Time to Prepare a Transmittal

050.06 Log Transmittal of Space Program

- Avg. Number of Transmittals
- Time to Log

050.08 Log Receipt of Space Program

- Avg. Number of Transmittals
- Time to Log

050.09 Validate Space Program

 Avg. Time for Owners Rep to Validate Space Program

050.10.10 Send Comments

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal
- Avg. Number of Re-Submit Cycles

050.10.20 Log Transmittal of Space Program Comments

- Avg. Number of Transmittals
- Time to Log
- Avg. Number of Re-Submit Cycles

050.12 Log Receipt of Space Program Comments

- Avg. Number of Transmittals
- Time to Log
- Avg. Number of Re-Submit Cycles

050.13 Re - Search for Space Program Criteria as Necessary

- Avg. Percentage of Errors in Space Program
- Number of Space Types per Building
- Avg. Time Spent Searching for Space Program Criteria
- Avg. Number of Re-Submit Cycles

050.14 Send Revised Copies of Space Program

Reference variables in section 050.05 Send Copies of Space Program. Include the following:

Avg. Number of Re-Submit Cycles

050.15 Log Transmittal of Revised Space Program
Reference variables in section 050.06 Log Trans-
mittal of Space Program. Include the following:
 Avg. Number of Re-Submit Cycles

4.2.6 Develop program – product program

Contracted Exchange/Deliverable:	060 Product Program
Diagram:	Figure 23 in Appendix C
Beneficiaries:	Owner's Representative and Architect or Planner
Information Content:	 Facility product requirements
Potential Savings:	Recreating: Design professionals typically re-enter the Owner's product standards into the system they use for design. COBie-formatted product standards would permit direct transfer from the Owner to the Architect or Planner's system
	If the Owner's Representative returns the Product Program because it does not meet the Owner's product requirements, the Ar- chitect/Planner must recreate the Product Program.
	Validating: The Architect/Planner sends the Product Program to the Owner's Representative for review. Currently, this is done by comparing 2 documents. Use of COBie format would permit automated checking.
	 If the Architect/Planner could automate checking of his work product against the Owner's requirements, then a rework/re- review cycle could be eliminated.
	Copying: Reproduction savings from reliance on electronic documents and the elimination of paper

Handling:

Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense.
 Managed electronic collaboration systems will notify intended recipients when edocuments are released and automatically log both the issuing and viewing of those documents

Process Specific Variables:

060.03 Search for Product Program Criteria as Necessary

- Number of Unique Product Types
- Avg. Time Spent Searching for Product Program Criteria

060.04 Send Copies of Product Program to Owner for Review

- Avg. Number of Pages in Product Program
- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Number of Pre-Design Submittal Sets Required
- Avg. Time to Prepare a Transmittal

060.05 Log Transmittal of Product Program

- Avg. Number of Transmittals
- Time to Log

060.07 Log Receipt Product Program

- Avg. Number of Transmittals
- Time to Log

060.08 Validate Product Program

Avg. Time for Owners Rep to Validate Product Program

060.09.10 Send Comments

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal
- Avg. Number of Re-Submit Cycles

060.09.20 Log Transmittal of Product Program

Comments

- Avg. Number of Transmittals
- Time to Log
- Avg. Number of Re-Submit Cycles

060.11 Log Receipt of Product Program Comments

- Avg. Number of Transmittals
- Time to Log
- Avg. Number of Re-Submit Cycles

060.12 Re - Search for Product Program Criteria as Necessary

- Avg. Percentage of Errors in Product Program
- Number of Unique Product Types
- Avg. Time Spent Searching for Product Program Criteria
- Avg. Number of Re-Submit Cycles

060.13 Send Revised Copies of Product Program

Reference variables in section 060.04 Send Copies of Product Program to Owner for Review. Include the following:

Avg. Number of Re-Submit Cycles

060.14 Log Transmittal of Revised Product Program

Reference variables in section 060.05 Log Transmittal of Product Program. Include the following:

Avg. Number of Re-Submit Cycles

4.2.7 Prepare invitation to bid and receive proposal (pre-design)

Contracted Ex-	070 Request for Proposal (RFP for Design Ser-
change/Deliverable:	vices)
Diagram:	
	in Appendix C
Beneficiaries:	Owner's Representative, Architect and Architect's
	Consultants
Information Content:	 Project Definition
	Space Program

	Product Program
Potential Savings:	Copying: Reproduction savings from reliance on electronic documents and the elimination of paper in both soliciting and submitting proposals Handling: Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. A managed electronic collaboration system with a "bidding" module can handle distribution of Requests for Proposal, receiving questions, issuing addenda and receiving and securing the proposals submitted by design firms.
Process Specific Variables:	070.02 Send Copies of Request for Proposal (RFP) Package

Avg. Time to Prepare a Transmittal

4.2.8 Explore concepts – design early

Contracted Ex- change/Deliverable:	080 Design Early
Diagram:	Figure 25 in Appendix C
Beneficiaries:	Owner's Representative, Architect and Architect's Consultants
Information Content:	Concept Design DrawingsCost EstimateCalculations
Potential Savings:	Reformatting: Although the Owner's requirements might be provided as e-documents, the design team typically reformats the information to be compatible with their design systems. COBie-formatted requirements data permits direct transfer from the Owner to the design consultants' systems.
	Recreating: • If the Owner's Representative rejects the Concept Design because it does not meet the Owner's space requirements, the Architect must recreate the Concept Design.
	Validating: COBie would permit the Architect to automate checking of his Concept Design against the Owner's space requirements, saving the Architect time and potentially eliminating a rework/re-review cycle.
	The Architect sends the Design Early documents to the Owner's Representative for review. Currently, this review is done manually. Use of COBie format would permit automated checking of space program at this phase.
	Copying: Reproduction savings from reliance on elec-

tronic documents and the elimination of paper

 In a paper-based process, review comments often need to be transferred to multiple document copies.

Handling:

Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense.
 Managed electronic collaboration systems will notify intended recipients when edocuments are released and automatically log both the issuing and viewing of those documents

Process Specific Variables:

080.03 Send Copies of Design Requirements

- Avg. Number of Pages in Space Program
- Avg. Number of Pages in Product Program
- Avg. Number of Pages in Project Definition
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

080.04 Log Transmittal of Design Requirements

Time to Log

080.06 Log Receipt of Design Requirements

Time to Log

080.08 Reformat Design Requirements

- Number of Space Types per Building
- Avg. Time Spent Reformatting Space Program
- Number of Unique Product Types
- Avg. Time Spent Reformatting Product Program
- Percentage of Time Spent by Licensed Professional Architect
- Percentage of Time Spent by Architectural Drafter

080.12 Validate Checkset Before Submission

Through Manual QA/QC Process

 Avg. Time Spent Evaluating Design Early Drawings Against Design Requirements – Space and Equipment

080.13.10 Make Corrections (Architect and/or Consultants)

 Avg. Time Spent Making Corrections due to Non-Conformance with Space or Product Program

080.13.20 Copy Design Early Documents

- Avg. Number of Sheets in Design Early Drawings
- Avg. Number of Letter-Sized Pages in Design Early Narrative
- Number of Design Submittal Sets Required
- Avg. In-house Reproduction Time per Set

080.13.30 Send Design Early Documents

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

080.13.40 Log Transmittal of Design Early Documents

- Avg. Number of Transmittals
- Time to Log

080.15 Log Receipt of Design Early Documents

- Avg. Number of Transmittals
- Time to Log

080.16 Validate Design Early Documents

 Avg. Time to Review Design Early Drawings for conformance to Space and Product Program

080.17.20 Send Comments to Design Team

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

080.17.30 Log Transmittal of Comments

- Avg. Number of Transmittals
- Time to Log

080.19 Log Receipt of Comments

- Avg. Number of Transmittals
- Time to Log

080.20 Make Corrections (Architect and/or Consultants)

- Avg. Time Spent Making Corrections due to Non-conformance with Space or Product Program
- Avg. Number of Re-Submit Cycles

080.21 Copy Revised Design Early Documents

Reference variables in section 080.13.20 Copy Design Early Documents. Include the following:

Avg. Number of Re-Submit Cycles

080.22 Send Revised Early Documents

Reference variables in section 080.13.30 Send Design Early Documents. Include the following:

Avg. Number of Re-Submit Cycles

080.23 Log Transmittal of Revised Design Early Documents

Reference variables in section 080.13.40 Log Transmittal of Design Early Documents. Include the following:

Avg. Number of Re-Submit Cycles

080.25 Log Receipt of Revised Design Early Documents

Reference variables in section 080.15 Log Receipt of Design Early Documents. Include the following:

Avg. Number of Re-Submit Cycles

080.26 Validate Revised Design Early Documents

Reference variables in section 080.16 Validate Design Early Documents. Include the following:

Avg. Number of Re-Submit Cycles

080.27 Send Comments to Design Team

Reference variables in section 080.17.20 Send

Comments to Design Team. Include the following:

Avg. Number of Re-Submit Cycles

O80.28 Log Transmittal of Comments
Reference variables in section 080.17.30 Log
Transmittal of Comments. Include the following:

Avg. Number of Re-Submit Cycles

O80.30 Log Receipt of Comments
Reference variables in section 080.19 Log Transmittal of Comments. Include the following:

Avg. Number of Re-Submit Cycles:

4.2.9 Develop design - design schematic

Contracted Exchange/Deliverable:	090 Design Schematic
Diagram:	Figure 26 in Appendix C
Beneficiaries:	Owner's Representative, Architect and Architect's Consultants
Information Content:	 Basis of Design Narrative Design Schematic Drawings Energy Analysis Life Cycle Cost Analysis Cost Estimate Geotechnical Report Calculations Outline Specification Color Boards Environmental Report
Potential Savings:	Recreating: Design Schematic phase requires quantity take-offs (QTOs) for cost estimating. QTOs are a recreation of information because the items have already been documented in the drawings or BIM. COBie addresses spaces and products/equipment. It provides space areas and product types and counts. If the Owner's Representative rejects the Design Schematic documents because the design does not meet the Owner's space or

product requirements, the Architect must recreate the design.

Reformatting:

• Although the Owner's requirements might be provided as e-documents, the design team spends considerable time developing product type templates (or BIM content), as well as specifications. COBie-formatted requirements data could be used directly.

Validating:

- If the Architect and his Consultants could automate checking of their design against the Owner's space and product requirements, they would save checking time and a rework/re-review cycle could potentially be eliminated.
- The Architect sends the Design Schematic documents to the Owner's Representative for review. Currently, this is review is done manually. Use of COBie format would permit automated checking of space and product program at this phase.

Copying:

- Reproduction savings from reliance on electronic documents and data and the elimination of paper
- In a paper-based process, review comments often need to be transferred to multiple document copies.

Handling:

Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense.
 Managed electronic collaboration systems will notify intended recipients when edocuments are released and automatically log both the issuing and viewing of those documents

Process Specific Variables:

090.02.10 Produce Design Schematic Documents

- Avg. Number of Plan Drawings in Design Schematic Drawings
- Avg. QTO Time for Equipment Components
- Avg. QTO Time for Spaces in Building
- Percentage of Time Spent by Licensed Professional Architect
- Percentage of Time Spent by Architect Drafter

090.02.20 Produce Outline Specification / Product Type Templates

- Number of Unique Product Types
- Avg. Time Spent Developing Equipment Type Templates

090.05 Validate Checkset Before Submission Through Manual QA/QC Process – Space and Equipment

Avg. Time Spent Evaluating Design Schematic Drawings Against Design Requirements – Space and Equipment

090.06.10 Make Corrections (Architect and/or Consultants)

 Avg. Time Spent Making Corrections due to Non-Conformance with Space or Product Program

090.06.20 Copy Design Schematic & Product Type Template Documents

- Avg. Number of Sheets in Design Schematic Drawings
- Avg. Number of Letter-Sized Pages in Design Schematic Narrative
- Avg. Number of Letter-Sized Pages in Design Schematic Specifications
- Number of Design Submittal Sets Required
- Avg. In-house Reproduction Time per Set

090.06.30 Send Design Schematic & Product Type Template Documents

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

090.06.40 Log Transmittal of Design Schematic & Product Type Template Documents

- Avg. Number of Transmittals
- Time to Log

090.08 Log Receipt of Design Schematic & Product Type Template Documents

- Avg. Number of Transmittals
- Time to Log

090.09 Validate Design Schematic Space & Product Type Template Documents

 Avg. Time to Review Design Schematic Drawings for conformance to Space and Product Program

090.10.20 Send Comments to Design Team

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

090.10.30 Log Transmittal of Comments

- Avg. Number of Transmittals
- Time to Log

090.12 Log Receipt of Comments

- Avg. Number of Transmittals
- Time to Log

090.13 Make Corrections (Architect and/or Consultants)

- Avg. Time Spent Making Corrections due to Non-conformance with Space or Product Program
- Avg. Number of Re-Submit Cycles

090.14 Copy Revised Design Schematic & Product Type Template Documents

Reference variables in section 090.06.20 Copy Design Schematic Documents. Include the following:

Avg. Number of Re-Submit Cycles

090.15 Send Revised Design Schematic & Prod-

uct Type Template Documents

Reference variables in section 090.06.30 Send Design Schematic Documents. Include the following:

Avg. Number of Re-Submit Cycles

090.16 Log Transmittal of Revised Design Schematic & Product Type Template Documents

Reference variables in section 090.06.40 Log Transmittal of Design Schematic Documents. Include the following:

Avg. Number of Re-Submit Cycles

090.18 Log Receipt of Revised Design Schematic & Product Type Template Documents

Reference variables in section 090.08 Log Receipt of Design Schematic Documents. Include the following:

Avg. Number of Re-Submit Cycles

090.19 Validate Revised Design Schematic Space & Product Type Template Documents

Reference variables in section 090.09 Validate Design Schematic & Product Type Template Documents. Include the following:

Avg. Number of Re-Submit Cycles

090.20 Send Comments to Design Team

Reference variables in section 090.10.20 Send Comments to Design Team. Include the following:

Avg. Number of Re-Submit Cycles

090.21 Log Transmittal of Comments

Reference variables in section 090.10.30 Log Transmittal of Comments. Include the following:

Avg. Number of Re-Submit Cycles

090.23 Log Receipt of Comments

Reference variables in section 090.12 Log Receipt of Comments. Include the following:

Avg. Number of Re-Submit Cycles

4.2.10 Develop design – design coordinated

Contracted Exchange/Deliverable:	100 Design Coordinated, Product Type Template, Product Type Candidates
Diagram:	Figure 27 in Appendix C
Beneficiaries:	Owner's Representative, Architect and Architect's Consultants, Specifier
Information Content:	 Basis of Design Narrative Design Coordinated Drawings Energy Analysis Life Cycle Cost Analysis Cost Estimate Geotechnical Report Calculations Detailed Specifications Submittal Register Project Information Form Color Boards
Potential Savings:	Recreating: Design Coordinated phase requires quantity take-offs (QTOs) for cost estimating. QTOs are a recreation of information because the items have already been documented in the drawings or BIM. COBie addresses spaces and products/equipment. It provides space areas and product types and counts. If the Owner's Representative rejects the Design Coordinated documents because the design does not meet the Owner's space or product requirements, the Architect must recreate the design. Reformatting: Although the Owner's requirements might be provided as e-documents, the design
	team spends considerable time developing product type templates (or BIM content), as well as specifications. COBie-formatted requirements data could be used directly.

Searching:

Candidate Products (typically 3 qualifying products) are identified for each product type template. This is done through reviewing product literature. Standard, structured product data available in COBie format would allow automated product selection based on the product type templates.

Validating:

- If the Architect and his Consultants could automate checking of their design against the Owner's space and product requirements, they would save checking time and a rework/re-review cycle could potentially be eliminated.
- The Architect sends the Design Coordinated documents to the Owner's Representative for review. Currently, this is review is done manually. Use of COBie format would permit automated checking of space areas and product data against Owner requirements.

Copying:

- Reproduction savings from reliance on electronic documents and data and the elimination of paper
- In a paper-based process, review comments often need to be transferred to multiple document copies.

Handling:

Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense.
 Managed electronic collaboration systems will notify intended recipients when edocuments are released and automatically log both the issuing and viewing of those documents.

Process Specific Vari-

100.02.10 Produce Design Coordinated Documents

ables:

- Avg. Number of Plan Drawings in Design Coordinated Drawings
- Avg. QTO Time for Equipment Components
- Avg. QTO Time for Spaces in Building
- Percentage of Time Spent by Licensed Professional Architect
- Percentage of Time Spent by Architect Drafter

100.02.20 Produce Detailed Specification / Product Type Templates

- Number of Unique Product Types
- Avg. Time Spent Developing Detailed Equipment Type Templates

100.03 Search for Product Type Candidates

- Number of Unique Product Types
- Avg. Time Searching for Product Literature for Candidates

100.06 Validate Checkset before Submission through Manual QA/QC Process

Avg. Time Spent Evaluating Design Coordinated Drawings Against Design Requirements – Space and Equipment

100.07.05 Make Corrections (Architect and/or Consultants)

 Avg. Time Spent Making Corrections due to Non-Conformance with Space Program

100.07.10 Re-Search and Recreate Product Type Candidates and Detailed Specifications Based on QA/QC Results

- Avg. Percent of Errors in Product Type Candidate
- Number of Unique Product Types
- Avg. Time Searching for Product Literature for Candidates

100.07.20 Copy Design Coordinated & Product Type Candidate Documents

Avg. Number of Sheets in Design Coordinated Drawings

- Avg. Number of Letter-Sized Pages in Design Coordinated Narrative
- Avg. Number of Letter-Sized Pages in Design Coordinated Specifications
- Number of Design Submittal Sets Required
- Avg. In-house Reproduction Time per Set

100.07.30 Send Design Coordinated Documents Product Type Candidate Documents

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

100.07.40 Log Transmittal of Design Coordinated & Product Type Candidate Documents

- Avg. Number of Transmittals
- Time to Log

100.09 Log Receipt of Design Coordinated & Product Type Template Documents

- Avg. Number of Transmittals
- Time to Log

100.10 Validate Design Coordinated Space & Product Type Candidate Documents

 Avg Time to Review Design Coordinated Drawings for conformance to Space and Product Program

100.11.20 Send Comments to Design Team

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

100.11.30 Log Transmittal of Comments

- Avg. Number of Transmittals
- Time to Log

100.13 Log Receipt of Comments

- Avg. Number of Transmittals
- Time to Log

100.14 Make Corrections (Architect and/or Consultants)

Avg. Time Spent Making Corrections Due to

Non-Conformance with Space Program

Avg. Number of Re-Submit Cycles

100.15 Copy Revised Design Coordinated & Product Type Candidate Documents

Reference variables in section 100.07.20 Copy Design Coordinated Documents. Include the following:

Avg. Number of Re-Submit Cycles

100.16 Send Revised Design Coordinated & Product Type Candidate Documents

Reference variables in section 100.07.30 Send Design Coordinated Documents. Include the following:

Avg. Number of Re-Submit Cycles

100.17 Log Transmittal of Revised Design Coordinated & Product Type Candidate Documents

Reference variables in section 100.07.40 Log Transmittal of Design Coordinated Documents. Include the following:

Avg. Number of Re-Submit Cycles

100.19 Log Receipt of Revised Design Coordinated & Product Type Candidate Documents

Reference variables in section 100.09 Log Receipt of Design Coordinated Documents. Include the following:

Avg. Number of Re-Submit Cycles

100.20 Validate Revised Design Coordinated & Product Type Candidate Documents

Reference variables in section 100.10 Validate Design Coordinated & Product Type Template Documents. Include the following:

Avg. Number of Re-Submit Cycles

100.21 Send Comments to Design Team

Reference variables in section 100.11.20 Send Comments to Design Team. Include the follow

4.2.11 Finalize design – design final

Diagram:	Figure 28 in Appendix C
_	
Beneficiaries:	Owner's Representative, Architect and Architect's Consultants, Specifier
Information Content:	 Basis of Design Narrative Design Final Drawings Cost Estimate Calculations Environmental Report Project Information Form Specifications Environmental Specifications Submittal Register Quality Control Data Color Documentation Binder Code Compliance Certification
Potential Savings:	Recreating: Design Final phase requires quantity take- offs (QTOs) for cost estimating. QTOs are a recreation of information because the items have already been documented in the draw- ings or BIM. COBie addresses spaces and products/equipment. It provides space are- as and product types and counts. Validating:

Design Final requires a Quality Control Review to evaluate both technical accuracy and discipline coordination. COBie supports automate checking of the design against the Owner's space and product requirements, saving checking time.

Copying:

- Reproduction savings from reliance on electronic documents and data and the elimination of paper.
- In a paper-based process, review comments often need to be transferred to multiple document copies.

Handling:

Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense.
 Managed electronic collaboration systems will notify intended recipients when edocuments are released and automatically log both the issuing and viewing of those documents.

Process Specific Variables:

110.02.10 Produce Design Final Documents

- Avg. Number of Plan Drawings in Design Final Drawings
- Avg. QTO Time for Equipment Components
- Avg. QTO Time for Spaces in Building
- Percentage of Time Spent by Licensed Professional Architect
- Percentage of Time Spent by Architect Drafter

110.02.20 Produce Detailed Specification / Product Type Candidates

- Number of Unique Product Types
- Avg. Time Spent Developing Detailed Equipment Type Candidate

110.05 Validate Checkset Before Submission Through Manual QA/QC Process

 Avg. Time Spent Evaluating Design Final Drawings Against Design Requirements – Space and Equipment

110.06.10 Make Corrections

 Avg. Time Spent Making Corrections due to Non-Conformance with Space Program

110.06.20 Copy Design Final Documents

- Avg. Number of Sheets in Design Final Drawings
- Avg. Number of Letter-Sized Pages in Design Final Narrative
- Avg. Number of Letter-Sized Pages in Design Final Specification
- Number of Design Submittal Sets Required
- Avg. In-house Reproduction Time per Set

110.06.30 Send Design Final Documents

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

110.06.40 Log Transmittal of Design Final Documents

- Avg. Number of Transmittals
- Time to Log

110.08 Log Receipt of Design Final Documents for Bidding Process

- Avg. Number of Transmittals
- Time to Log

4.2.12 Prepare invitation to bid and receive proposals (post design)

Contracted Exchange/Deliverable:	120 Request for Proposal (RFP for Construction)
Diagram:	Figure 29 in Appendix C
Beneficiaries:	Owner's Representative
Information Content:	Final Design DocumentsSpecifications

Potential Savings: Copying: Reproduction savings from reliance on electronic documents and the elimination of paper in both soliciting and submitting proposals Handling: Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. A managed electronic collaboration system with a "bidding" module can handle distribution of Requests for Proposal, receiving questions, issuing addenda and receiving and securing the bids submitted by Contractors. **Process Specific Vari-**120.01 Receive Information from A/E to Develables: op Bid Documents Time to Log 120.03 Copy Request for Proposal (RFP) Package Avg. Number of Pages in Front Matter Avg. Number of Sheets in Design Final **Drawings** Avg. Number of Letter-Sized Pages in Design Final Narrative Avg. Number of Letter-Sized Pages in Design Final Specifications Avg. Number of Request for Proposal Submittal Sets Required Avg. In-house Reproduction Time per Set 120.04 Send Request for Proposal (RFP) Package Avg. Number of Transmittals Avg. Mailing Cost per Transmittal Avg. Time to Prepare a Transmittal

4.2.13 Respond to pre-proposal inquiries

Contracted Ex-	130 Inquiry Issue (Clarification)
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change/Deliverable:	
Diagram:	Figure 30 in Appendix C
Beneficiaries:	Owner's Representative, Contractor and Architect
Information Content:	 Clarification Request
Potential Savings:	Handling: • Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. A managed electronic collaboration system with a "bidding" module can handle receipt of bidder questions and issuing addenda.
Process Specific Variables:	130.04 Send Inquiry Issue (Clarification) Avg. Number of Transmittals Avg. Mailing Cost per Transmittal Avg. Time to Prepare a Transmittal 130.05 Log Transmittal of Inquiry Issue (Clarification) Avg. Number of Transmittals Time to Log 130.07 Log Receipt of Inquiry Issue (Clarification) Avg. Number of Transmittals Time to Log 130.08 Send Inquiry Issue (Clarification) to Architect Avg. Number of Transmittals Avg. Mailing Cost per Transmittal Avg. Time to Prepare Transmittals Avg. Time to Prepare Transmittals for Inquiry Issues 130.09 Log Transmittal of Inquiry Issue (Clarification) Avg. Number of Transmittals Time to Log 130.11 Log Receipt of Inquiry Issue (Clarification) Avg. Number of Transmittals
	tion)

130.13 Send Inquiry Issue (Clarification) Response

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare Transmittals for Inquiry Issues

130.14 Log Transmittal of Inquiry Issue (Clarification) Response

- Avg. Number of Transmittals
- Time to Log

130.16 Log Receipt of Inquiry Issue (Clarification) Response

- Avg. Number of Transmittals
- Time to Log

130.18 Send Inquiry Issue (Clarification) Response to Contractor

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare Transmittals for Inquiry Issues

130.19 Log Transmittal of Inquiry Issue (Clarification) Response

- Avg. Number of Transmittals
- Time to Log

130.21 Log Receipt of Inquiry Issue (Clarification) Response

- Avg. Number of Transmittals
- Time to Log

4.2.14 Develop pre-construction plan

Contracted Exchange/Deliverable:	140 Pre-Construction Plan
Diagram:	Figure 31 in Appendix C
Beneficiaries:	None
Information Content:	Equipment ListsCertificates of Insurance

	 Surety Bonds List of Proposed Subcontractors List of Proposed Producers Construction Progress Schedule Network Analysis Schedule Submittal Register Schedule of Prices Health and Safety Plans Work Plan Quality Control plan Environmental Protection Plan
Potential Savings:	None
Process Specific Variables:	None

4.2.15 Identify discrepancies

Contracted Exchange/Deliverable:	150 Inquiry Issue (RFI)
Diagram:	Figure 32 in Appendix C
Beneficiaries:	Contractor, Owner's Representative, Architect and Subcontractors
Information Content:	 Request for Information (RFI)
Potential Savings:	Handling: • Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. Managed electronic collaboration systems typically have an RFI module that logs the questions and responses and tracks the time until a response is provided. These systems have proven to reduce RFI turnaround time.
Process Specific Variables:	 150.04 Send Inquiry Issue (RFI) Avg. Number of RFIs Avg. Mailing Cost per Transmittal Avg. Time to Prepare Transmittals for Inquiry Issues (RFI) 150.05 Log Transmittal of Inquiry Issue (RFI) Avg. Number of RFIs

Time to Log

150.07 Log Receipt of Inquiry Issue (RFI)

- Avg. Number of RFIs
- Time to Log

150.08 Send Inquiry Issue (RFI)

- Avg. Number of RFIs
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare Transmittals for Inquiry Issues (RFI)

150.09 Log Transmittal of Inquiry Issue (RFI)

- Avg. Number of RFIs
- Time to Log

150.11 Log Receipt of Inquiry Issue (RFI)

- Avg. Number of RFIs
- Time to Log

150.13 Send Inquiry Issue (RFI) Response

- Avg. Number of RFIs
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare Transmittals for Inquiry Issues (RFI)

150.14 Log Transmittal of Inquiry Issue (RFI) Response

- Avg. Number of RFIs
- Time to Log

150.16 Log Receipt of Response of Inquiry Issue (RFI)

- Avg. Number of RFIs
- Time to Log

150.18 Send Inquiry Issue (RFI) Response to Contractor

- Avg. Number of RFIs
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare Transmittals for Inquiry Issues (RFI)

150.19 Log Transmittal of Inquiry Issue (RFI) Response

Avg. Number of RFIsTime to Log
150.21 Log Receipt of Inquiry Issue (RFI) Re-
sponseAvg. Number of RFIs
Time to Log

4.2.16 Prepare submittal information – product type selection

Contracted Exchange/Deliverable:	160 Product Type Selection
Diagram:	Figure 33 in Appendix C
Beneficiaries:	None
Information Content:	 Product Data Samples Design Data Test Reports Certificates Manufacturer's Instructions Manufacturer's Field Reports Operations and Maintenance Data
Potential Savings:	None
Process Specific Variables:	None

4.2.17 Prepare submittal information – system layout

Contracted Exchange/Deliverable:	170 System Layout
Diagram:	Figure 34 in Appendix C
Beneficiaries:	None
Information Content:	Shop Drawings
Potential Savings:	None
Process Specific Variables:	None

4.2.18 Organize submittal information

Contracted Exchange/Deliverable:	180 Submittal Package
Diagram:	Figure 35 in Appendix C
Beneficiaries:	Contractor, Owner's Representative, Architect and Subcontractors
Information Content:	 Product Submittals Product Type Selection Other Submittals Schedules System Layouts (Shop Drawings) Samples Certificates Manufacturer's Instructions Field Test Reports Operations and Maintenance Manuals
Potential Savings:	Reformatting: Contractors and Subcontractors must extract product requirements from the specifications. COBie provides product requirements in a concise, computable form.
	 Contractors must compile disparate product data formats into Product Submittal Items and Submittal Packages for the Architect's approval. COBie formats product data consistently.
	Validating: Contractors must validate product data against the specifications before including them in a Submittal. COBie supports automate checking of the data against the product specifications, saving time and reducing the number of Product Submittals rejected. This reduces rework.(See Recreating above.)
	Copying: Reproduction savings from reliance on electronic documents and data and the elimination of paper

 In a paper-based process, review comments often need to be transferred to multiple Submittal copies.

Handling:

Elimination of administrative costs associated with handling paper document Submittals as well as the delivery expense. These costs are high, due to the large number of documents and the requirement for multiple copies. Managed electronic collaboration systems will notify reviewers when Submittal Packages are uploaded, automatically log both the release and the reviewing of those documents and track ball-in-court responsibility and due dates.

Process Specific Variables:

180.02.15 Log Receipt of Submittal Package from Sub-Contractors and Vendors

- Avg. Number of Transmittals
- Time to Log

180.02.20 Produce Submittal Information

- Number of Unique Product Types
- Avg. Time Spent Organizing Equipment (Product) Type Information

180.03 Validate Submittal Information against Contract Documents

- Number of Unique Product Types
- Avg. Time Spent Evaluating Equipment (Product) Type Submittal Items Against Contract Documents
- Percentage of Submittal Items Rejected
- Percentage of Time Spent by Construction Project Manager
- Percentage of Time Spent by Assistant (Construction) Project Manager

180.05 Copy Submittal Package

- Avg. Number of Submittal Pages in a Submittal Item
- Avg. Number of Submittal Sheets in a Sub-

- mittal Item
- Avg. Number of Submittal Items in a Product Submittal Package
- Number of Unique Product Types
- Number of Submittal Sets Required
- Avg. In-house Reproduction Time per Set

180.06 Stamp Submittal Package

- Avg. Number of Submittal Pages in a Submittal Item
- Avg. Number of Submittal Sheets in a Submittal Item
- Avg. Number of Submittal Items in a Product Submittal Package
- Number of Submittal Sets Required
- Avg. Time to Sign each Page
- Avg. Time to Stamp each Sheet

180.07 Send Submittal Package

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

180.08 Log Transmittal of Submittal Package

- Avg. Number of Transmittals
- Time to Log

180.10 Log Receipt of Submittal Package

- Avg. Number of Transmittals
- Time to Log

180.12 Send Submittal Package to Architect

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

180.13 Log Transmittal of Submittal Package

- Avg. Number of Transmittals
- Time to Log

180.15 Log Receipt of Submittal Package

- Avg. Number of Transmittals
- Time to Log

4.2.19 Perform submittal review – submittal issue

Contracted Exchange/Deliverable:	190 Submittal Issue
Diagram:	Figure 36 in Appendix C
Beneficiaries:	Architect, Consultants, Contractor and Subcontractors
Information Content:	Marked-Up Submittal PackageSubmittal Review Comments
Potential Savings:	Recreating: If a Submittal Item is rejected by the reviewer (typically the Architect and the Architect's Consultants), the Contractor or Subcontractor must redo the Submittal. COBie supports automated validation product characteristics against the specification, lowering the number of Product Submittals rejected.
	 Validating: Submittal reviewers (typically the Architect and the Architect's Consultants) must also check Product Submittal data against the specifications. COBie supports automated checking, saving time. Copying: Reproduction savings from reliance on electronic documents and data and the elimination of paper
	 In a paper-based process, review comments often need to be transferred to multiple Submittal copies.
	 Handling: Elimination of administrative costs associated with handling paper document Submittals as well as the delivery expense. These costs are high, due to the large number of documents and the requirement for multiple copies. Managed electronic collabora-

tion systems will notify reviewers when Submittal Issues are uploaded, automatically log both the release and the reviewing of those documents and track ball-in-court responsibility and due dates.

Process Specific Variables:

190.02.10 Send Copies of Submittal Package (Product Type Selection, System Layout) to Sub-Consultants

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

190.02.11 Log Transmittal of Submittal Package (Product Type Selection, System Layout)

- Avg. Number of Transmittals
- Time to Log

190.02.13 Log Receipt of Sub Consultants Submittal Mark-ups/Comments

- Avg. Number of Transmittals
- Time to Log

190.02.20 Validate Submittal Package Not Sent to Sub-Consultants

- Number of Unique Product Types
- Avg. Time Spent Evaluating Product Type Submittal Items Against Contract Documents
- Percentage of Product Submittals reviewed by Licensed Architect

190.02.21 Mark-up Copies of Submittals with Comments

- Avg. Number of Submittal Pages in a Submittal Item
- Avg. Number of Submittal Sheets in a Submittal Item
- Avg. Number of Submittal Items in a Product Submittal Package
- Number of Unique Product Types
- Avg. Time Spent Transferring Comments per Page
- Avg. Time Spent Transferring Comments per Sheet

Number of Submittal Sets Required

190.03.10 Send Copies of Submittal Issues

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

190.03.20 Log Transmittal of Submittal Issues

- Avg. Number of Transmittals
- Time to Log

190.05 Log Receipt of Submittal Issues

- Avg. Number of Transmittals
- Time to Log

190.06.10 Recreate Submittal Package (Product Type Selection, System Layout)

- Number of Unique Product Types
- Avg. Time Spent Revising One Product Submittal Item
- Percentage of Product Submittals Rejected on First Review
- Percentage of Time Spent by Construction Project Manager
- Percentage of Time Spent by Assistant (Construction) Project Manager

4.2.19.1

4.2.19.2 190.07 2^{nd} Review Cycle of Submittal Package

.19.3 (Product Type Selection, System yout)

 Percentage of Product Submittals rejected on 2nd Review

4.2.19.4 190.08 3rd Review Cycle of Submittal Package (Product Type Selection, System Layout)

 Percentage of Product Submittals rejected on 3rd Review

190.09 4th Review Cycle of Submittal Package (Product Type Selection, System Layout)

 Percentage of Product Submittals rejected on 4th Review

4.2.20 Provide resources

Contracted Ex-	200 Purchase Order
change/Deliverable:	
Diagram:	Figure 37 in Appendix C
Beneficiaries:	None
Information Content:	Purchase Order
Potential Savings:	None
Process Specific Vari-	None
ables:	

4.2.21 Execute construction activities

Contracted Ex- change/Deliverable:	210 Product Installation
Diagram:	Figure 38 in Appendix C
Beneficiaries:	Architect, Contractor and Subcontractors
Information Content:	 Design Final Drawings and Product Type Candidate Approved Shop Drawings Manufacturer's Installations
Potential Savings:	Reformatting: While the project is ongoing, the Contractor must continually prepare a Product Installation report that describes the status of installed components and corresponding data. The Contractor then spends time in the office processing these notes and compiling the Report. The COBie worksheet would be a vehicle for field data entry, as well as a reference to components. This would allow the Contractor to reduce office time.
	Handling: • Elimination of administrative costs associated with handling paper documents as well as the delivery expense.
Process Specific Variables:	 210.04 Reformat Product Installation Report Number of Tagged Components Avg. Time Spent Re-formatting Product Installation Report in Office

210.05 Send Product Installation Report to Architect/ Owner's Rep

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

210.06 Log Transmittal of Product Installation Report

- Avg. Number of Transmittals
- Time to Log

210.08 Log Receipt of Product Installation Report

- Avg. Number of Transmittals
- Time to Log

4.2.22 Perform equipment testing

Contracted Ex-	220 Equipment Start-Up Report
change/Deliverable:	
Diagram:	Figure 39 in Appendix C
Beneficiaries:	None
Information Content:	 Equipment Start-Up Test Results
Potential Savings:	None
Process Specific Variables:	None

4.2.23 Inspect and approve work

Contracted Exchange/Deliverable:	230 Product Inspection Report
Diagram:	Figure 40 in Appendix C
Beneficiaries:	Architect and Contractor
Information Content:	 Observation Field Report
Potential Savings:	Reformatting: The Architect must validate each Contractor Pay Request through a site visit to determine work progress. Typically, the Architect takes drawings to the site to check that items billed have been put in place. The Architect also notes any defects in workman-

ship. The Architect then spends time in the office composing field notes and quantifying work put in place to support or refute the Pay Request. COBie would provide a definitive list of items required per room or floor that could be "checked off" and automatically totaled. This would allow the Architect to reduce office time.

Handling:

Elimination of administrative costs associated with handling paper documents as well as the delivery expense. Managed electronic collaboration systems can notify the Contractor if the Pay Request has been accepted or rejected and deliver the Observation Field Report with tracking.

Process Specific Variables:

230.04 Reformat Product Inspection

- Avg. Field Time Spent Documenting Report per Site Visit
- Avg. Number of Site Visits per Month
- Avg. Number of Months of Construction
- Total Time Spent in the Office
- Avg. Percentage of Office Time Spent Quantifying Products-in-Place

230.05 Send Product Inspection Report to Contractor

- Avg. Number of Transmittals
- Avg. Mailing Cost per Transmittal
- Avg. Time to Prepare a Transmittal

230.06 Log Transmittal of Product Inspection Report

- Avg. Number of Transmittals
- Time to Log

230.08 Log Receipt of Product Inspection Report

- Avg. Number of Transmittals
- Time to Log

4.2.24 Define, record and certify discrepancies

|--|

change/Deliverable:	
Diagram:	Figure 41 in Appendix C
Beneficiaries:	None
Information Content:	Punchlist Issues
Potential Savings:	None
Process Specific Variables:	None

4.2.25 Closeout

Contracted Ex-	250 Turnover Package
change/Deliverable:	
Diagram:	in Appendix C
Beneficiaries:	Contractor, Subcontractors and Owner
Information Content:	 Operations and Maintenance Manuals Commissioning Report Record Specifications Record (As-Built) Drawings Final Approved Shop Drawings and Product Submittals
Potential Savings:	Searching: Contractor must assemble the Turnover Package. A managed electronic collaboration system stores and indexes all documents submitted as they are uploaded. This greatly reduces the time required to find the necessary documents and assemble the Turnover Package, saving the Contractor time, improving the completeness and quality of the Turnover Package, and making the Turnover Package available to the Owner at an earlier date.
	Copying: Reproduction savings from turnover of electronic documents and data and the elimination of paper. Typically four sets of Turnover documents are required.
	Handling:

Elimination of administrative costs associated with handling paper documents as well as the delivery expense. Process Specific Vari-250.01 Compile Turnover Package Avg. Time Spent Searching and Assembling ables: **Operations & Maintenance Manuals** Avg. Time Spent Searching and Assembling **Commissioning Report** Avg. Time Spent Searching and Assembling **Record Specifications** Avg. Number of Sheets in Record (As-Built) **Drawings** Avg. Time Spent Searching and Assembling Record (As-Built) Drawings Avg. Number of Sheets in Final Approved Shop Drawings Avg. Time Spent Searching and Assembling Final Approved Shop Drawings Percentage of Time Spent by Construction **Project Manager** Percentage of Time Spent by Assistant (Construction) Project Manager 250.02 Copy Turnover Package Avg. Number of Pages In Operations & **Maintenance Manuals** Number of Unique Product Types Avg. Number of Pages In Commissioning Report Avg. Number of Components & Systems to be Commissioned Avg. Number of Pages In Record Specifica-Avg. Number of Sheets in Record (As-Built) **Drawings** Avg. Number of Sheets in Final Approved **Shop Drawings** Number of Submittal Sets Required Avg. In-house Reproduction Time per Set 250.03 Send Copies of Turnover Package Avg. Mailing Cost per Transmittal Avg. Time to Prepare a Transmittal 250.04 Log Transmittal of Turnover Package

Time to Log

250.06 Log Receipt of Turnover Package

Time to Log

250.07 Review Turnover Package

- Avg. Number of Pages in Operations & Maintenance Manuals
- Avg. Time Spent Reviewing Operations & Maintenance Manuals
- Avg. Number of Pages in Commissioning Report
- Avg. Time Spent Reviewing Commissioning Report
- Avg. Number of Pages in Record Specifications
- Avg. Time Spent Reviewing Record Specifications
- Avg. Number of Sheets in Record (As-Built) Drawings
- Avg. Time Spent Reviewing Record (As-Built) Drawings
- Avg. Number of Sheets in Final Approved Shop Drawings
- Avg. Time Spent Reviewing Final Approved Shop Drawings

250.08 File Turnover Package

- Avg. Time Spent Filing Operations & Maintenance Manuals
- Avg. Time Spent Filing Commissioning Report
- Avg. Time Spent Filing Record Specifications
- Avg. Number of Sheets in Record (As-Built)
 Drawings
- Avg. Time Spent Filing Record (As-Built) Drawings
- Avg. Number of Sheets in Final Approved Shop Drawings
- Avg. Time Spent Filing Final Approved Shop Drawings

5 How to use the COBie Calculator

The COBie Calculator is designed to compare current and expected life cycle information exchange process costs. See Chapter 3 and 4 for further description of the Current and Expected Processes and Appendix E for the current and expected values of the cost variables.

The Calculator only addresses variables whose values are affected by using either an electronic collaboration system and/or a structured data format.

5.1 General overview

The COBie Calculator is subdivided into the tabs listed below:

- Introduction
- Current Assumptions
- Expected Assumptions
- Summary
- 25 Life Cycle information exchange (LCie) Processes (010 Facility Criteria, 020 Discipline Specifications, etc.)

To use the COBie Calculator:

- 1. Determine processes and tasks of interest.
- 2. Enter project and relevant process specific costs into Current Assumptions sheet.
- 3. Adjust reduction factors on Expected Assumptions sheet as required.
- 4. View overall savings and savings by actor on Summary sheet.
- 5. View cost and savings detail on relevant LCie process tabs.

5.2 Detailed description

5.2.1 Introduction tab

The Introduction tab, Figure 1, shows the color-coding for the major project phases and variable types. Color-coding is used in the Calculator for ease of identification and understanding.

COBie Calculator This research will identify the potential savings/cost for a project team if information is exchanged using a Purpose: COBie-based approach over the traditional "Paper-Based" approach. Project Phase Color Coding Criteria Project Definition Requirement Bidding Design Construction Assumptions Tab | Assumptions were made when developing the COBie Calculator. These assumptions should be modified based on your project variables in order to calculate the potential savings Information LEGEND Attributes Allowed User Actions Color Description user defined information unique to this worksheet change on inputs worksheet in project phase variables section common user information, listed on assumptions worksheet change on inputs worksheet do not change this cell

Figure 1. Introduction tab.

No information or data is required to be keyed into this tab.

5.2.2 Current Assumptions tab

The Current Assumptions tab is the most important tab in the Calculator. It lists the 210 variables associated with the various tasks in the business process model. These variables are classified as:

- Owner Project/Program Variables
- Project Variables
- Pre-Design Variables
- Design Variables
- Estimating Process Variables
- Submittal Process Variables
- Organizational Variables
- General Repro/Postal Delivery Cost Variables
- Process Specific Variables

The default values in this tab have been set to "0", leaving the user to input data for the variables that are applicable to the project (Value column). Once the data is entered, the expected assumptions, summary and 19 of the LCie tabs in the Calculator are populated automatically. Six of the LCie processes are not affected by the use of COBie and managed electronic communications. They are included in the LCie process tabs, but have no associated cost variables.

As shown in Figure 2, the Current Assumptions tab is broken down by variable name, value (where all data is keyed in), units, definitions and tab reference. The Tab Reference column indicates where the variables are used within the Calculator to allow for easy referencing.

Inputs				
	Value	Unit	Definitions	Tab Reference
Owner Project / Program Variables				
Avg. Number of Pages in Facility Criteria	2	pages	Estimated number of pages in Owners initial analysis of Project need and Scope.	10
Avg. Number of Pages in Discipline Specification	43	pages	Estimated number of pages in Equipment performance requirements during planning	20
Avg. Number of Pages in Project Definition	43	pages	Estimated number of pages in Project Definition document. The Project Definition defines the project scope, budget requirements, site details, economic analysis and facility planning data	40,70,80

Figure 2. Current Assumptions tab.

There are a few assumptions that apply to an Owner organization or a project as a whole; however, most assumptions are phase or task specific. For example, an Owner may use an in-house Architect during Pre-Design. The hourly cost of that Architect would be his or her direct cost. However, once the project is scoped, the Design may be completed by an external Architectural firm. Their hourly rates would include overhead and profit. Similarly, in-house reproduction costs may differ from reimbursable reproduction from an outside Architect.

The Current Process assumes a completely paper-based process. Therefore, if a paper-based process has been eliminated from the end user's procedures, "0" should be entered for all variables that are related to paper documentation. Similarly, if a managed electronic collaboration system is in use, enter "0" for "Avg. Mailing Cost per Transmittal." Variables that do not apply to the end user's procedures but are identified in the LCie processes should be left at "0".

Only the Value column should be altered in this tab. All other columns are locked.

5.2.3 Expected Assumptions tab

The Expected Assumptions tab, Figure 3, has a similar layout as the Current Assumptions tab. It introduces the "Reduction Factor" column, which comes pre-populated, and the "Expected Outcome" column.

As data is input for the variables in the Current Assumptions tab, the Current Value column automatically populates in the Expected Assumptions

tab. The "Expected Outcome" column is automatically calculated based on the "Reduction Factor" where applicable. See Figure 3.

The reduction factors derive from the elimination, automation, or streamlining of tasks that involve recreating, reformatting, validating, handling, copying, and searching activities. If the value of a variable is not lower in the Expected Process, it remains the same as on the Current Assumptions tab and is shown in black text. Where cost savings are anticipated, the variables and values are in red text.

Figure 3. Expected Assumptions.

NOTE: Red text indicates variables affected by the expected process.				
Inputs				
	Current Value	Unit	Redution Factor	Outcome
Owner Project / Program Variables				
Avg. Number of Pages in Facility Criteria	2	pages		2.00
Avg. Number of Pages in Discipline Specification	43	pages		43.00
Avg. Number of Pages in Project Definition	43	pages		43.00
Avg. Number of Pages in Front Matter	25	pages		25.00
Project Variables				
Number of Equipment (product) Types (Types / project)	50	types / project		50.00
Number of Tagged Components (components / project)	1706	components / project		1706.00
Number of Space Types per Building	19	space types / building		19.00
Time to Log (hours / transmittal)	0.25	hours / transmittal	100%	0.00
Project Phase Variables				
Facility Criteria			Redution Factor	Expected
Avg. Number of Sets Required (sets / submittal)	2	sets / submittal	100%	0.00
Avg. In-house Reproduction Time Per Set (hours/set)	0.001	hours/set	100%	0.00
Discipline Specification				
Avg. Number of Sets Required (sets / submittal)	2	sets / submittal	100%	0.00
Avg. In-house Reproduction Time Per Set (hours/set)	0.029	hours/set	100%	0.00
Feasibility Study				
Avg. Number of Transmittals	2	Transmittals	•	2.00
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0.068	hours / submittal	100%	0.00
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	\$20.10	\$ / Transmittal	100%	\$0.00
	0.5	hours /	60%	0.20

The reduction factors have been assigned default values. Copying and handling activities have a reduction factor of 100% because they will be eliminated due to the use of electronic documentation. Recreating activities are primarily identified in repetitive quantity takeoffs and resubmission of construction product data submittals. The Calculator ambitiously estimates that 100% of this rework will be eliminated due to an automated search and validation of product data. Anecdotal evidence indicates that design consultants spend a large amount of time extracting requirements from government text documents and putting them in a useful format; therefore, the Calculator assumes that at least a 100% savings can be achieved in reformatting. For the checking time needed to validate space program and product selection, the Calculator assumes a 90% time reduction. Streamlining activities have a reduction factor of 60%. The reduction factor is based on an actual comparison between paper based processes and the same processes performed in an electronic collaboration environment at the Chicago Transit Authority (CTA) (Fallon 2003).

The end user is encouraged to adjust the reduction factors based on his organization's Current and Expected Processes. All other columns are locked excluding the reduction factor column are locked.

5.2.4 Summary tab

Figure 4, shows the Cost Summary tab for the 25 LCie processes. This cost summary reflects savings from potential elimination, streamlining and automation of tasks and not reduction of total project costs.

This tab is itemized collectively by Current Processes, Expected Processes, savings, and percentage savings. The summary is further broken down by role i.e. Owner/Owner's Representative, Architect, and Contractor.

Figure 4. Summary tab.

No information or data is required to be keyed into this tab. It is automatically populated upon filling out the Current Assumptions tab.

5.2.5 Life Cycle Information Exchange Process tabs

The 25 LCie Process tabs are populated based on the Current Assumptions and Expected Assumptions tabs. 19 out of the 25 processes have been identified for potential savings due to the use of an electronic collaboration system and a structured data format (COBie). The 6 processes where these two factors would not bring about any savings or improve efficiency are: 140 Pre-construction Plan, 160 Product Type Selection, 170 System Layout, 200 Purchase Order, 220 Start-Up, and 240 Punchlist Issue. These processes are included in the LCie tabs but have no cost variables associated with them.

As seen in Figure 5, each LCie Process tab contains a header that contains the process name, OmniClass stage and role, process description, and breakdown of the activities based on the LCie process maps.

Process Name Design Coordinated & Product Type Candidate
OmniClass Stage 31-20 20 11 Detailed Design Phase
OmniClass Role 34-25 21 00 Architect

Description The Architect further develops the approved Design Schematic deliverable documents to produce the Design Coordinated documents. In addition, the building systems are coordinated to eliminate spatial interferences. This is a major coordination submittal before the final delivery package. The Architect performs a QA/QC check before distributing to the Owner's Representative. After receiving the submission, the Owner's Representative reviews and provides comments to the Architect. The Architect and Consultants are then required to update the documents based on the comments. After revisions are made, the Architect resubmits.

Figure 5. LCie Process Tab: Header.

Each of these process tabs is then further divided into Current and Expected Processes as seen in Figure 6. The Current Process is on the left and the Expected Process is on the right.

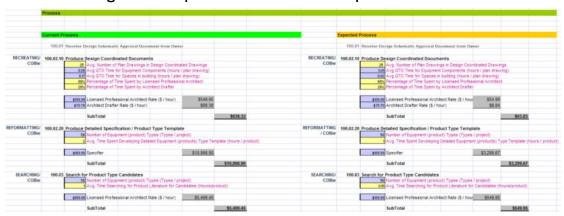


Figure 6. LCie process tab: Current and Expected Processes.

The process tabs show item by item exactly where cost savings are achieved and their magnitude. Data that is keyed in by the end user in the Current Assumptions tab populates the variables listed on the Current Process side and data from the Expected Outcome column in the Expected Assumptions tab fills the variables listed on the Expected Process side.

The end user should not make any changes or input data on the individual process tabs (e.g. 01 Facility Criteria). All adjustments should be made on the Current Assumptions and Expected Assumptions tabs.

The "Information Attributes" summary, as seen in Figure 7, shows an overall summary of the processes (current and expected) based on the costs attributed to each of the role players.

Information Attributes							
					Owner	Architect	Contractor
Current pro	ocess cost:	\$	27,356.26	\$	1,061.96	\$25,952.89	\$ -
Expected pro	cess cost:	\$	4,086.31	\$	53.14	\$4,033.18	\$ -
Process Cost [Difference:	S	23,269,94	S	1.008.82	\$ 21.919.71	\$ -

Figure 7. LCie Process tab: Information Attributes.

At any time the LCie worksheets can be navigated to see how the variables and reduction factor affect each Life Cycle stage.

5.3 Example

The illustration below, Figure 8, is a section from the "current" LCie for the Design Coordinated business process model.

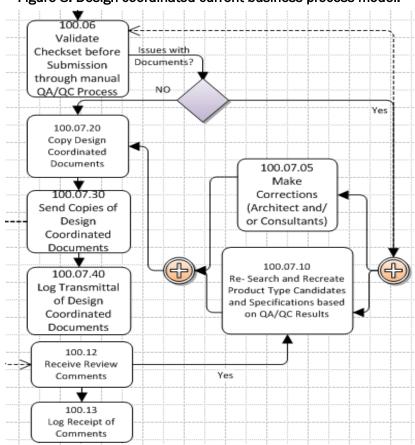


Figure 8. Design coordinated current business process model.

Figure 9 shows the Current Process costs for the above section broken down into its relevant cost variables.

in Figure 10.

VALIDATING/ 100.06 Validate Checkset before Submission through manual QA/QC Process 9.60 Avg. Time Spent Evaluating Design Coordinated Drawings against Design Requirements - Space and Equipment CORie \$109.99 Licensed Professional Architect Rate (\$ / hour) \$1,055.89 SubTotal RECREATING/ 100.07.05 Make Corrections (Architect and/or Consultants) 3.10 Avg. Time spent making corrections due to non-conformance with Space Program COBie \$109.99 Licensed Professional Architect Rate (\$ / hour) SEARCHING & 100.07.10 Re- Search and Recreate Product Type Candidates and Detailed Specifications based on QA/QC Results RECREATING/ 15% Avg. Percent of Errors in Product Type Candidate COBie Number of Equipment (product) Types (Types / project) vg. Time Searching for Product Literature for Candidates (Hours/product) \$109.99 Licensed Professional Architect Rate (\$ / hour) SubTotal 100.07.20 Copy Design Coordinated Documents COPYING/ ELEC.DOC vg. Number of Sheets in Design Coordinated Drawings Avg. Number of Letter Sized Pages in a Design Coordinated Narrative Avg. Number of Letter Sized Pages in a Design Coordinated Specification 6 Number of Design Submittal Sets Reqd. (sets / submittal) \$0.15 Avg. Per Page Copy Cost (\$ / page) \$3.00 Avg. Per Sheet Copy Cost (\$ / sheet) lvg. In-house Reproduction Time Per Set (hours/set) \$70.70 Architect Drafter Rate (\$ / hour) \$262.59 Copying Cost \$2,916.00 SubTotal \$3,178.59 100.07.30 Send Design Coordinated Documents HANDLING/ Avg. Number of Transmittals (Transmittals) Avg. Mailing Cost per Transmittal (\$ / Transmittal) ELEC.DOC lvg. Time to Prepare a Transmittal (hours/transmittal) \$70.70 Architect Drafter Rate (\$ / hour) Mailing Cost \$47.70

Figure 9. Design coordinated current process costs.

With the aid of electronic documentation and a structured data format, some tasks will be eliminated, streamlined, or automated and some will remain unchanged. This is reflected in the corresponding Expected Process LCie for the Design Coordinated business process model shown below

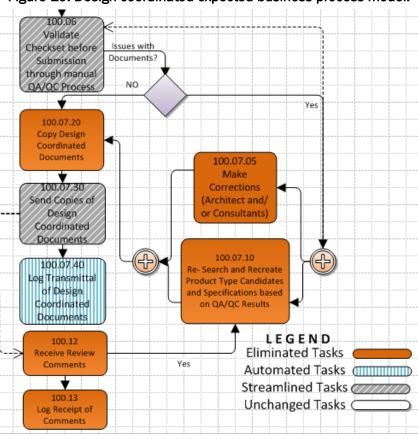


Figure 10. Design coordinated expected business process model.

Figure 11 shows the corresponding Expected Process costs broken down into their relevant cost variables. The boxed variables reflect a reduction in cost of the Expected Process. Based on the values assigned to the variables in the Current Assumptions tab and the Reduction Factors assigned on the Expected Assumptions tab, the Current Process cost for the Validate Checkset before Submission Through a Manual QA/QC Process amounts to \$1,055.89, while the corresponding Expected Process cost is \$105.59. There is a 90% savings.

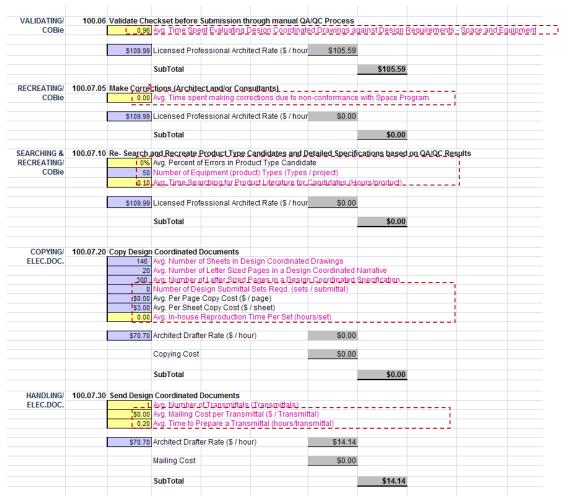


Figure 11. Design coordinated expected process.

In summary, the COBie Calculator is a tool for estimating Current and Expected costs related to the specification, documentation and fulfillment of managed asset requirements (space and products).

The Calculator can be used to evaluate up to 19 Life Cycle processes. Current costs are entered in the Current Assumptions tab and reduction factors are entered on the Expected Assumptions tab. Results can be viewed on the Summary Tab, and in detail, on each Life Cycle Process tab.

6 Project Analyses

To test the COBie Calculator, the National Institute of Building Sciences' three experimental BIM models (Duplex Apartment, Office Building, and Medical Clinic) were utilized (NIBS 2012d). These models were used as a representation of residential, commercial and medical facilities. In addition, a Chicago Transit Authority (CTA) station program was analyzed.

The 210 variables related to the specification, documentation and fulfillment of managed asset requirements were populated based on drawings, space inventories, specifications, equipment schedules and product data sheets where available. For the Transit program, an electronic collaboration system provided additional details such as number of resubmissions of design review documents and construction product data submittals as well as designers time sheets and billing rates. This information was augmented by published cost indices, project information from additional owners, and the professional experience of the authors. Appendix E documents the source of each current cost and reduction factor assumption for the transit station program. Note that the Total Summary cost is **not** the full cost of design and construction.

The baseline, or Current Process, used in analyzing all sample projects assumed a paper-based communication and documentation system and no use of data exchanges in a standard, structured data format (COBie). The Expected Process assumed an electronic collaboration communication and documentation system and use of standard, structured data (COBie) for data exchanges. The COBie Calculator determined the expected values of the variables affected.

A Medical Clinic, Office building and CTA Transit Station are documented in this chapter.

6.1 Medical Clinic

The Medical Clinic experimental BIM, seen in Figure 12, is based on a federal medical and dental building. The Medical Clinic's statistics are:

Size: 49,571 SF

of Product Types: 155

• # of Components: 3,950

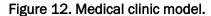




Table 1 shows the overall cost summary of the individual LCie Processes.

Table 1. Clinic cost summary.

	Table 1. Clinic cost summary.						
	Cost Summa	•					
OmniClass Project Phase	Current	Expected	Savings	%			
(Table31)	Process	Process		Savings			
LCie 01 - Facility Criteria	-	-	1	0%			
LCie 02 - Design Specification	\$135.00	-	\$135.00	100%			
LCie 03 - Feasibility Study	\$670.00	\$10.00	\$660.00	99%			
	_						
LCie 04 - Project Definition		-	1	0%			
LCie 05 - Space Program	\$840.00	\$10.00	\$830.00	99%			
LCie 06 - Product Program	\$1,900.00	\$5.00	\$1,895.00	99%			
LCie 07 - Request for Proposal	\$900.00	\$100.00	\$800.00	89%			
LCie 08 - Design Early	\$20,840.00	\$300.00	\$20,900.00	98%			
LCie 09 - Design Schematic	\$33,400.00	\$1,900.00	\$31,500.00	94%			
LCie 10 -Design Coordinated	\$91,100.00	\$12,600.00	\$82,700.00	86%			
LCie 11 - Design Final	\$30,400.00	\$2,200.00	\$28,200.00	93%			
LCie 12 - Request for Proposal	\$1,990.00	\$30.00	\$1,960.00	98%			
LCie 13 - Inquiry Issue	\$1,210.00	\$30.00	\$1,180.00	98%			
LCie 14 - Pre-Construction Plan	-		-	0%			
LCie 15 - Inquiry Issue (RFI)	\$1,800.00	-	\$1,800.00	100%			
LCie 16 - Product Type Selection	-			0%			
LCie 17 - System Layout	-	-	-	0%			
LCie 18 - Submittal Package	\$60,700.00	\$5,000.00	\$55,700.00	92%			
LCie 19 - Submittal Issue	\$214,600.00	\$500.00	\$214,100.00	99%			
LCie 20 - Purchase Order	-	-	-	0%			
LCie 21 - Product Installation	\$94,800.00	-	\$94,800.00	100%			
LCie 22 - Start-Up	-	-	-	0%			
LCie 23 - Product Inspection	\$29,100.00	\$1,200.00	\$27,900.00	96%			
LCie 24 - Punchlist Issue	-	-	-	0%			
LCie 25 - Turnover Package	\$14,100.00	\$100.00	\$14,000.00	99%			
Total	\$598,000.00	\$24,000.00	\$574,000.00	96%			

Tables 2-4 show the cost savings breakdown among Owner/Owner's Representative, Architect, and Contractor.

Table 2. Clinic cost summary - Owner/Owner's Representative.

Breakdown by Role						
Co	ost Summary - Owne	er / Owners Rep)			
OmniClass Project Phase	Current Process	Expected Process	Savings	% Savings by Role		
LCie 01 - Facility Criteria	-	-	-	0%		
LCie 02 - Design Specification	\$135.00	-	\$135.00	100%		
LCie 03 - Feasibility Study	\$75.00	\$5.00	\$70.00	93%		
LCie 04 - Project Definition	-	-	-	0%		
LCie 05 - Space Program	\$120.00	\$5.00	\$115.00	96%		
LCie 06 - Product Program	\$70.00	-	\$70.00	100%		
LCie 07 - Request for Proposal	\$760.00	\$30.00	\$730.00	96%		
LCie 08 - Design Early	\$6,400.00	\$200.00	\$6,200.00	97%		
LCie 09 - Design Schematic	\$4,400.00	\$100.00	\$4,300.00	98%		
LCie 10 -Design Coordinated	\$4,400.00	\$100.00	\$4,300.00	98%		
LCie 11 - Design Final	\$5.00	ı	\$5.00	100%		
LCie 12 - Request for Proposal	\$1,990.00	\$30.00	\$1,960.00	98%		
LCie 13 - Inquiry Issue	\$145.00	\$5.00	\$140.00	97%		
LCie 14 - Pre-Construction Plan	-	-	-	0%		
LCie 15 - Inquiry Issue (RFI)	\$560.00	-	\$560.00	100%		
LCie 16 - Product Type Selection	-	-	-	0%		
LCie 17 - System Layout	-	-	-	0%		
LCie 18 - Submittal Package	\$11,400.00	\$1,200.00	\$10,200.00	89%		
LCie 19 - Submittal Issue	-	-	-	0%		
LCie 20 - Purchase Order	-	-	-	0%		
LCie 21 - Product Installation	-	-	-	0%		
LCie 22 - Start-Up	-	-	-	0%		
LCie 23 - Product Inspection	-	-	-	0%		
LCie 24 - Punchlist Issue	-	-	-	0%		
LCie 25 - Turnover Package	\$190.00	\$70.00	\$120.00	63%		
Total	\$31,000.00	\$1,700.00	\$28,900.00	93%		

Table 3. Clinic cost summary - Architect.

	Cost Summary -	Architect		
	Current	Expected	Savings	% Savings
OmniClass Project Phase	Process	Process	Javiligs	by Role
LCie 01 - Facility Criteria	- 1000	-	_	0%
LCie 02 - Design Specification	_	-	_	0%
LCie 03 - Feasibility Study	\$590.00	-	\$590.00	100%
LCie 04 - Project Definition	Ç550.00	-	Ş330.00	0%
LCie 05 - Space Program	\$720.00	-	\$720.00	100%
LCie 06 - Product Program	\$1,800.00	-	\$1,800.00	100%
LCie 07 - Request for Proposal	\$1,800.00	\$30.00	\$1,800.00	82%
LCie 08 - Design Early	\$170.00	\$170.00	\$140.00	99%
<u> </u>	\$14,420.00	\$1,800.00	\$27,300.00	94%
LCie 09 - Design Schematic	' '			
LCie 10 - Design Coordinated	\$85,900.00	\$12,500.00	\$73,400.00	85%
LCie 11 - Design Final	\$30,300.00	\$2,200.00	\$28,100.00	93%
LCie 12 - Request for Proposal	40.000	-	-	0%
LCie 13 - Inquiry Issue	\$240.00	\$10.00	\$230.00	96%
LCie 14 - Pre-Construction Plan	-	-	-	0%
LCie 15 - Inquiry Issue (RFI)	\$700.00	\$10.00	\$690.00	99%
LCie 16 - Product Type Selection	-	-	-	0%
LCie 17 - System Layout	-	-	-	0%
LCie 18 - Submittal Package	\$6,000.00	-	\$6,000.00	100%
LCie 19 - Submittal Issue	\$207,500.00	\$500.00	\$207,000.00	100%
LCie 20 - Purchase Order	-	-	-	0%
LCie 21 - Product Installation	\$40.00	-	\$40.00	100%
LCie 22 - Start-Up	-	-	1	0%

LCie 23 - Product Inspection	\$29,100.00	\$1,200.00	\$27,900.00	96%
LCie 24 - Punchlist Issue	-	ı	ı	0%
LCie 25 - Turnover Package	=	-	-	0%
Total	\$415,500.00	\$18,700.00	\$388,200.00	95%

Table 4. Clinic cost summary – Contractor.

	Cost Summary - Contractor						
OmniClass Project Phase	Current Process	Expected Process	Savings	% Savings by Role			
LCie 01 - Facility Criteria	-	-	-	0%			
LCie 02 - Design Specification	-	-	-	0%			
LCie 03 - Feasibility Study	ı	ı	ı	0%			
LCie 04 - Project Definition	-	-	1	0%			
LCie 05 - Space Program	-	-	-	0%			
LCie 06 - Product Program	-	-	-	0%			
LCie 07 - Request for Proposal	-	-	1	0%			
LCie 08 - Design Early	-	-	-	0%			
LCie 09 - Design Schematic	-	-	-	0%			
LCie 10 -Design Coordinated	-	-	-	0%			
LCie 11 - Design Final	-	-	-	0%			
LCie 12 - Request for Proposal	-	-	-	0%			
LCie 13 - Inquiry Issue	\$820.00	\$10.00	\$810.00	99%			
LCie 14 - Pre-Construction Plan	-	-	-	0%			
LCie 15 - Inquiry Issue (RFI)	\$500.00	-	\$500.00	100%			
LCie 16 - Product Type Selection	-	-	-	0%			
LCie 17 - System Layout	-	-	-	0%			
LCie 18 - Submittal Package	\$43,200.00	\$3,900.00	\$39,300.00	91%			
LCie 19 - Submittal Issue	\$7,020.00	\$40.00	\$6,980.00	99%			
LCie 20 - Purchase Order	-	-	-	0%			
LCie 21 - Product Installation	\$94,800.00	-	\$94,800.00	100%			
LCie 22 - Start-Up	-	-	=	0%			
LCie 23 - Product Inspection	\$20.00	-	\$20.00	100%			
LCie 24 - Punchlist Issue	-	-	-	0%			
LCie 25 - Turnover Package	\$13,960.00	\$50.00	\$13,910.00	100%			
Total	\$160,300.00	\$4,000.00	\$156,300.00	98%			

6.2 Office

The Office experimental BIM, seen in Figure 13, is based on a real two story, mid-sized office building. The Office building statistics are:

• Size: 40,053 SF

of Product Types: 50# of Components: 1,706

Figure 13. Office building model.



Table 5 shows the overall cost summary of the individual LCie Processes.

Table 5. Office cost summary.

Table 5. Office cost summary.							
	Cost Summary						
OmniClass Project Phase (Table31)	Current Process	Expected Process	Savings	% Savings			
LCie 01 - Facility Criteria	-	-	-	0%			
LCie 02 - Design Specification	\$15.00	-	\$15.00	100%			
LCie 03 - Feasibility Study	\$560.00	\$25.00	\$535.00	96%			
LCie 04 - Project Definition	\$10.00	-	\$10.00	100%			
LCie 05 - Space Program	\$615.00	\$10.00	\$605.00	98%			
LCie 06 - Product Program	\$790.00	\$5.00	\$785.00	99%			
LCie 07 - Request for Proposal	\$800.00	\$100.00	\$700.00	88%			
LCie 08 - Design Early	\$5,300.00	\$90.00	\$5,210.00	98%			
LCie 09 - Design Schematic	\$9,900.00	\$600.00	\$9,300.00	93%			
LCie 10 -Design Coordinated	\$26,300.00	\$4,100.00	\$22,200.00	85%			
LCie 11 - Design Final	\$12,900.00	\$900.00	\$12,000.00	93%			
LCie 12 - Request for Proposal	\$930.00	\$30.00	\$900.00	97%			
LCie 13 - Inquiry Issue	\$1,210.00	\$30.00	\$1,180.00	98%			
LCie 14 - Pre-Construction Plan	-	-	-	0%			
LCie 15 - Inquiry Issue (RFI)	\$1,280.00	\$10.00	\$1,270.00	95%			
LCie 16 - Product Type Selection	-	-	-	0%			
LCie 17 - System Layout	-	-	-	0%			
LCie 18 - Submittal Package	\$34,400.00	\$3,000.00	\$31,400.00	91%			
LCie 19 - Submittal Issue	\$73,500.00	\$400.00	\$73,100.00	99%			
LCie 20 - Purchase Order	-			0%			
LCie 21 - Product Installation	\$41,005.00	\$5.00	\$41,000.00	100%			
LCie 22 - Start-Up	0	1	ì	0%			
LCie 23 - Product Inspection	\$15,900.00	\$600.00	\$15,300.00	96%			
LCie 24 - Punchlist Issue	-	-	-	0%			
LCie 25 - Turnover Package	\$6,300.00	\$100.00	\$6,200.00	98%			
-							
Total	\$232,000.00	\$10,000.00	\$222,000.00	96%			

Tables 6-8 show the cost savings breakdown among Owner/Owner's Representative, Architect, and Contractor.

Table 6. Office cost summary - Owner/Owner's Representative.

Breakdown by Role						
Cost Summary - Owner / Owners Rep						
OmniClass Project Phase Current Expected Savings % Savings						

	Process	Process		by Role
LCie 01 - Facility Criteria	-	-	-	0%
LCie 02 - Design Specification	\$15.00	-	\$15.00	100%
LCie 03 - Feasibility Study	\$90.00	\$10.00	\$80.00	89%
LCie 04 - Project Definition	\$10.00	-	\$10.00	100%
LCie 05 - Space Program	\$120.00	\$5.00	\$115.00	96%
LCie 06 - Product Program	\$60.00	1	\$60.00	100%
LCie 07 - Request for Proposal	\$700.00	\$30.00	\$670.00	96%
LCie 08 - Design Early	\$1,100.00	\$100.00	\$1,100.00	91%
LCie 09 - Design Schematic	\$1,100.00	ı	\$1,100.00	100%
LCie 10 -Design Coordinated	\$1,100.00	-	\$1,100.00	100%
LCie 11 - Design Final	\$5.00	-	\$5.00	100%
LCie 12 - Request for Proposal	\$930.00	\$30.00	\$900.00	97%
LCie 13 - Inquiry Issue	\$145.00	\$5.00	\$140.00	90%
LCie 14 - Pre-Construction Plan	-	-	-	0%
LCie 15 - Inquiry Issue (RFI)	\$410.00	-	\$410.00	100%
LCie 16 - Product Type Selection	-	-	-	0%
LCie 17 - System Layout	-	-	-	0%
LCie 18 - Submittal Package	\$7,400.00	\$700.00	\$6,700.00	91%
LCie 19 - Submittal Issue	-	-	-	0%
LCie 20 - Purchase Order	-	-	-	0%
LCie 21 - Product Installation	-	-	-	0%
LCie 22 - Start-Up	-	-	-	0%
LCie 23 - Product Inspection	-	-	-	0%
LCie 24 - Punchlist Issue	-	-	-	0%
LCie 25 - Turnover Package	\$80.00	\$50.00	\$30.00	38%
Total	\$13,000.00	\$900.00	\$12,300.00	95%

Table 7. Office cost summary - Architect.

Cost Summary - Architect				
OmniClass Project Phase	Current	Expected	Savings	% Savings
	Process	Process		by Role
LCie 01 - Facility Criteria	-	-	-	0%
LCie 02 - Design Specification	-	-	-	0%
LCie 03 - Feasibility Study	\$470.00	\$10.00	\$460.00	98%
LCie 04 - Project Definition	-	ī	-	0%
LCie 05 - Space Program	\$500.00	Ī	\$500.00	100%
LCie 06 - Product Program	\$700.00	-	\$700.00	100%
LCie 07 - Request for Proposal	\$140.00	\$30.00	\$110.00	79%
LCie 08 - Design Early	\$4,190.00	\$30.00	\$4,150.00	99%
LCie 09 - Design Schematic	\$8,900.00	\$600.00	\$8,300.00	93%
LCie 10 -Design Coordinated	\$24,900.00	\$4,000.00	\$20,900.00	84%
LCie 11 - Design Final	\$12,800.00	\$900.00	\$11,900.00	93%
LCie 12 - Request for Proposal	ı	-	-	0%
LCie 13 - Inquiry Issue	\$240.00	\$10.00	\$230.00	96%
LCie 14 - Pre-Construction Plan	ı	-	-	0%
LCie 15 - Inquiry Issue (RFI)	\$510.00	-	\$510.00	100%
LCie 16 - Product Type Selection	ı	1	-	0%
LCie 17 - System Layout	ı	-	-	0%
LCie 18 - Submittal Package	\$3,900.00	-	\$3,900.00	100%
LCie 19 - Submittal Issue	\$71,100.00	\$400.00	\$70,700.00	99%
LCie 20 - Purchase Order		-	-	0%
LCie 21 - Product Installation	\$40.00	-	\$40.00	100%
LCie 22 - Start-Up		-	-	0%
LCie 23 - Product Inspection	\$15,900.00	\$600.00	\$15,300.00	96%
LCie 24 - Punchlist Issue	-	-	-	0%
LCie 25 - Turnover Package	-	-	-	0%
Total	\$144,300.00	\$6,600.00	\$137,700.00	95%

Cost Summary - Contractor				
OmniClass Project Phase	Current	Expected	Savings	% Savings
	Process	Process		by Role
LCie 01 - Facility Criteria	-	-	-	0%
LCie 02 - Design Specification	-	-	-	0%
LCie 03 - Feasibility Study	-	-	-	0%
LCie 04 - Project Definition	-	-	-	0%
LCie 05 - Space Program	-	-	-	0%
LCie 06 - Product Program	-	ī	-	0%
LCie 07 - Request for Proposal	ı	-	-	0%
LCie 08 - Design Early	1	ī	-	0%
LCie 09 - Design Schematic	-	ī	-	0%
LCie 10 -Design Coordinated	ı	-	-	0%
LCie 11 - Design Final	ı	1	-	0%
LCie 12 - Request for Proposal	ı	1	1	0%
LCie 13 - Inquiry Issue	\$820.00	\$10.00	\$810.00	99%
LCie 14 - Pre-Construction Plan	-	ī	-	0%
LCie 15 - Inquiry Issue (RFI)	\$400.00	-	\$400.00	100%
LCie 16 - Product Type Selection	-	-	-	0%
LCie 17 - System Layout	-	-	-	0%
LCie 18 - Submittal Package	\$23,100.00	\$2,200.00	\$20,900.00	90%
LCie 19 - Submittal Issue	\$2,360.00	\$10.00	\$2,350.00	99%
LCie 20 - Purchase Order	ı	Ī	-	0%
LCie 21 - Product Installation	\$41,000.00	-	\$41,000.00	100%
LCie 22 - Start-Up		1	-	0%
LCie 23 - Product Inspection	\$20.00	-	\$20.00	100%
LCie 24 - Punchlist Issue		-	-	0%
LCie 25 - Turnover Package	\$6,240.00	\$50.00	\$6,190.00	99%
Total	\$73,900.00	\$2,300.00	\$71,700.00	97%

Table 8. Office cost summary – Contractor.

6.3 Transit station program

In addition to the 3 NIBS experimental models, a Chicago Transit Authority (CTA) station program was analyzed. Unlike the NIBS experimental models, the CTA utilized a web-based managed collaboration system with automated workflow and some paper-based communication in executing its projects. It did not make use of standard, structured data for exchanges. This process is referred to as the Hybrid Process. It reflects a common level of automation in the industry today.

With the information gathered from this project, 2 comparisons were developed:

- Paper-Based vs. Hybrid Process
 This was created to evaluate savings that could be associated with a transition from an entirely paper based process to the Hybrid process.
- Hybrid Process vs. Expected Process

This comparison evaluated the savings that could be gained from transitioning from the Hybrid process to one that combines use of an electronic collaboration environment with complete elimination of paper and the use of standard, structured data.

6.3.1 Paper-Based Process vs. Hybrid Process

Table 9 shows the overall cost summary of the individual LCie Processes.

Table 9. Transit station cost summary - Paper Based vs. Hybrid Process.

	Cost Summary					
	Current	Hybrid	Savings	%		
OmniClass Project Phase (Table31)	Process	Process		Savings		
LCie 01 - Facility Criteria	\$10.00	-	\$10.00	100%		
LCie 02 - Design Specification	\$200.00	-	\$200.00	100%		
LCie 03 - Feasibility Study	\$540.00	\$10.00	\$530.00	98%		
LCie 04 - Project Definition	\$10.00	-	\$10.00	100%		
LCie 05 - Space Program	\$700.00	\$500.00	\$200.00	29%		
LCie 06 - Product Program	\$1,700.00	\$800.00	\$900.00	53%		
LCie 07 - Request for Proposal	\$600.00	\$100.00	\$500.00	83%		
LCie 08 - Design Early	\$11,800.00	\$11,800.00	-	0%		
LCie 09 - Design Schematic	\$31,800.00	\$31,800.00	-	0%		
LCie 10 -Design Coordinated	\$68,100.00	\$68,100.00	-	0%		
LCie 11 - Design Final	\$28,900.00	\$28,200.00	\$700.00	2%		
LCie 12 - Request for Proposal	\$16,290.00	\$20.00	\$16,270.00	100%		
LCie 13 - Inquiry Issue	\$1,200.00	\$100.00	\$1,100.00	92%		
LCie 14 - Pre-Construction Plan	-	-	-	0%		
LCie 15 - Inquiry Issue (RFI)	\$206,900.00	\$26,000.00	\$180,900.00	87%		
LCie 16 - Product Type Selection	-	-	-	0%		
LCie 17 - System Layout	-	-	-	0%		
LCie 18 - Submittal Package	\$84,700.00	\$84,700.00	-	0%		
LCie 19 - Submittal Issue	\$61,400.00	\$61,400.00	-	0%		
LCie 20 - Purchase Order	-	-	-	0%		
LCie 21 - Product Installation	\$12,900.00	\$12,900.00	-	0%		
LCie 22 - Start-Up	-	-	-	0%		
LCie 23 - Product Inspection	\$326,800.00	\$326,800.00	-	0%		
LCie 24 - Punchlist Issue	-	-	-	0%		
LCie 25 - Turnover Package	\$15,400.00	\$15,400.00	-	0%		
Total	\$870,000.00	\$669,000.00	\$201,000.00	23%		

Tables 10 - 12 show the cost savings breakdown among Owner/Owner's Representative, Architect, and Contractor.

Table 10. Transit Station cost summary - Paper Based vs. Hybrid Process - Owner/Owner's Representative.

Breakdown by Role					
Cost Summary - Owner / Owners Rep					
OmniClass Project Phase Current Hybrid Savings % Savings Process Process by Role					
LCie 01 - Facility Criteria	\$10.00	-	\$10.00	100%	
LCie 02 - Design Specification	\$200.00	1	\$200.00	100%	
LCie 03 - Feasibility Study	\$100.00	1	\$100.00	100%	

LCie 04 - Project Definition	\$10.00	-	\$10.00	100%
LCie 05 - Space Program	\$120.00	\$60.00	\$60.00	50%
LCie 06 - Product Program	\$300.00	\$200.00	\$100.00	33%
LCie 07 - Request for Proposal	\$470.00	\$10.00	\$460.00	98%
LCie 08 - Design Early	\$2,500.00	\$2,500.00	-	0%
LCie 09 - Design Schematic	\$7,700.00	\$7,700.00	-	0%
LCie 10 -Design Coordinated	\$9,900.00	\$9,900.00	-	0%
LCie 11 - Design Final	•	-		0%
LCie 12 - Request for Proposal	\$16,290.00	\$20.00	\$16,270.00	100%
LCie 13 - Inquiry Issue	\$150.00	\$10.00	\$140.00	93%
LCie 14 - Pre-Construction Plan	•	-		0%
LCie 15 - Inquiry Issue (RFI)	\$65,600.00	\$1,300.00	\$64,300.00	98%
LCie 16 - Product Type Selection	ı	ı	ı	0%
LCie 17 - System Layout	ı	ı	1	0%
LCie 18 - Submittal Package	\$22,500.00	\$22,500.00	ı	0%
LCie 19 - Submittal Issue	ı	ı	1	0%
LCie 20 - Purchase Order	ı	ı	ı	0%
LCie 21 - Product Installation	ı	ı	ı	0%
LCie 22 - Start-Up	ı	ı	1	0%
LCie 23 - Product Inspection	•	-	-	0%
LCie 24 - Punchlist Issue	•	-	-	0%
LCie 25 - Turnover Package	\$260.00	\$260.00	1	0%
Total	\$126,000.00	\$44,500.00	\$81,700.00	65%

Table 11. Transit Station cost summary - Paper Based vs. Hybrid Process - Architect.

Cost Summary - Architect				
OmniClass Project Phase	Current Process	Hybrid Process	Savings	% Savings by Role
LCie 01 - Facility Criteria		-	-	0%
LCie 02 - Design Specification			-	0%
LCie 03 - Feasibility Study	\$450.00	\$10.00	\$440.00	98%
LCie 04 - Project Definition	ı	ı	-	0%
LCie 05 - Space Program	\$500.00	\$400.00	\$100.00	20%
LCie 06 - Product Program	\$1,400.00	\$600.00	\$800.00	57%
LCie 07 - Request for Proposal	\$200.00	\$100.00	\$100.00	50%
LCie 08 - Design Early	\$9,300.00	\$9,300.00	-	0%
LCie 09 - Design Schematic	\$24,200.00	\$24,200.00	-	0%
LCie 10 -Design Coordinated	\$57,300.00	\$57,300.00	-	0%
LCie 11 - Design Final	\$28,800.00	\$28,000.00	\$800.00	3%
LCie 12 - Request for Proposal	-	-	-	0%
LCie 13 - Inquiry Issue	\$240.00	\$40.00	\$200.00	83%
LCie 14 - Pre-Construction Plan	-	-	-	0%
LCie 15 - Inquiry Issue (RFI)	\$82,000.00	\$15,200.00	\$66,800.00	81%
LCie 16 - Product Type Selection	-	-	-	0%
LCie 17 - System Layout	-	-	-	0%
LCie 18 - Submittal Package	\$15,100.00	\$15,100.00	-	0%
LCie 19 - Submittal Issue	\$53,700.00	\$53,700.00	-	0%
LCie 20 - Purchase Order	-	-	-	0%
LCie 21 - Product Installation	\$40.00	\$40.00	-	0%
LCie 22 - Start-Up	-	-	-	0%
LCie 23 - Product Inspection	\$326,700.00	\$326,700.00	-	0%
LCie 24 - Punchlist Issue	-	-	-	0%
LCie 25 - Turnover Package	-	-	-	0%
Total	\$599,900.00	\$530,700.00	\$69,200.00	12%

Table 12. Transit Station cost summary - Paper Based vs. Hybrid Process - Contractor.

	Cost Summary - Contractor						
OmniClass Project Phase	Current Process	Hybrid Process	Savings	% Savings by Role			
LCie 01 - Facility Criteria	-	-	-	0%			
LCie 02 - Design Specification	-	-	-	0%			
LCie 03 - Feasibility Study	-	-	-	0%			
LCie 04 - Project Definition	•	-	-	0%			
LCie 05 - Space Program	-	-	-	0%			
LCie 06 - Product Program	-	-	-	0%			
LCie 07 - Request for Proposal	-	-	-	0%			
LCie 08 - Design Early	-	-	-	0%			
LCie 09 - Design Schematic	-	-	-	0%			
LCie 10 -Design Coordinated	-	-	-	0%			
LCie 11 - Design Final	-	-	-	0%			
LCie 12 - Request for Proposal	-	-	-	0%			
LCie 13 - Inquiry Issue	\$820.00	\$20.00	\$800.00	98%			
LCie 14 - Pre-Construction Plan	-	-	-	0%			
LCie 15 - Inquiry Issue (RFI)	\$59,200.00	\$9,500.00	\$49,700.00	84%			
LCie 16 - Product Type Selection	-	-	-	0%			
LCie 17 - System Layout	-	-	-	0%			
LCie 18 - Submittal Package	\$47,100.00	\$47,100.00	-	0%			
LCie 19 - Submittal Issue	\$7,700.00	\$7,700.00	-	0%			
LCie 20 - Purchase Order	-	-	-	0%			
LCie 21 - Product Installation	\$12,900.00	\$12,900.00	-	0%			
LCie 22 - Start-Up	-	-	-	0%			
LCie 23 - Product Inspection	\$20.00	\$20.00	-	0%			
LCie 24 - Punchlist Issue	-	-	-	0%			
LCie 25 - Turnover Package	\$15,100.00	\$15,100.00	-	0%			
Total	\$142,800.00	\$92,300.00	\$50,500.00	35%			

6.3.2 Hybrid Process vs. Expected Process

Table 13 shows the overall cost summary of the individual LCie Processes.

Table 13. Transit Station cost summary – Hybrid Process vs. Expected Process.

	Cost Summary							
OmniClass Project Phase (Table31)	Hybrid Process	Expected Process	Savings	% Savings				
LCie 01 - Facility Criteria	-	1	1	0%				
LCie 02 - Design Specification	-	•	ı	0%				
LCie 03 - Feasibility Study	\$10.00	\$10.00	ı	0%				
LCie 04 - Project Definition	-	ı	ı	0%				
LCie 05 - Space Program	\$510.00	\$10.00	\$500.00	98%				
LCie 06 - Product Program	\$890.00	\$30.00	\$860.00	97%				
LCie 07 - Request for Proposal	\$80.00	\$80.00	ı	0%				
LCie 08 - Design Early	\$11,800.00	\$300.00	\$11,500.00	97%				
LCie 09 - Design Schematic	\$31,800.00	\$1,500.00	\$30,300.00	95%				
LCie 10 -Design Coordinated	\$68,000.00	\$7,600.00	\$60,400.00	89%				
LCie 11 - Design Final	\$28,200.00	\$1,900.00	\$26,300.00	93%				
LCie 12 - Request for Proposal	\$20.00	\$10.00	\$10.00	50%				
LCie 13 - Inquiry Issue	\$100.00	\$100.00	ı	0%				
LCie 14 - Pre-Construction Plan	-	1	-	0%				
LCie 15 - Inquiry Issue (RFI)	\$3,200.00	\$300.00	\$2,900	91%				
LCie 16 - Product Type Selection		-)	0%				
LCie 17 - System Layout	ı	ı	ì	0%				
LCie 18 - Submittal Package	\$32,700.00	\$1,800.00	\$30,900.00	94%				
LCie 19 - Submittal Issue	\$61,400.00	\$500.00	\$60,900.00	99%				

LCie 20 - Purchase Order	6	-	-	0%
LCie 21 - Product Installation	\$12,900.00	•	\$12,900.00	100%
LCie 22 - Start-Up	•	-		0%
LCie 23 - Product Inspection	\$326,800.00	\$13,100.00	\$313,700.00	96%
LCie 24 - Punchlist Issue	•	-		0%
LCie 25 - Turnover Package	\$15,400.00	\$300.00	\$15,100.00	98%
Total	\$594,000.00	\$28,000.00	\$566,000.00	95%

Tables 14-16 show the cost savings breakdown among Owner/Owner's Representative, Architect, and Contractor.

Table 14. Transit Station cost summary - Hybrid Process vs. Expected Process - Owner/Owner's Representative.

Breakdown by Role							
Cost Summary - Owner / Owners Rep							
OmniClass Project Phase	Hybrid Process	Expected Process	Savings	% Savings by Role			
LCie 01 - Facility Criteria	-		-	0%			
LCie 02 - Design Specification				0%			
LCie 03 - Feasibility Study	-	-	-	0%			
LCie 04 - Project Definition				0%			
LCie 05 - Space Program	\$70.00	\$10.00	\$60.00	86%			
LCie 06 - Product Program	\$250.00	\$20.00	\$230.00	92%			
LCie 07 - Request for Proposal	\$10.00	\$10.00	-	0%			
LCie 08 - Design Early	\$2,480.00	\$80.00	\$2,400.00	97%			
LCie 09 - Design Schematic	\$7,660.00	\$260.00	\$7,400.00	97%			
LCie 10 -Design Coordinated	\$9,900.00	\$330.00	\$9,570.00	97%			
LCie 11 - Design Final	-	-	-	0%			
LCie 12 - Request for Proposal	\$20.00	\$10.00	\$10.00	50%			
LCie 13 - Inquiry Issue	\$10.00	\$10.00	-	0%			
LCie 14 - Pre-Construction Plan	-	-	-	0%			
LCie 15 - Inquiry Issue (RFI)	\$200.00	-	\$200.00	100%			
LCie 16 - Product Type Selection	-	-	-	0%			
LCie 17 - System Layout	-	-	-	0%			
LCie 18 - Submittal Package	\$6,600.00	\$100.00	\$6,500.00	98%			
LCie 19 - Submittal Issue	-	-	-	0%			
LCie 20 - Purchase Order	-	-	-	0%			
LCie 21 - Product Installation	-	-	-	0%			
LCie 22 - Start-Up	-	-	-	0%			
LCie 23 - Product Inspection	-	-	-	0%			
LCie 24 - Punchlist Issue	-	-	-	0%			
LCie 25 - Turnover Package	\$300.00	\$200.00	\$100.00	33%			
Total	\$28,000.00	\$1,000.00	\$26,500.00	95%			

Table 15. Transit Station cost summary - Hybrid Process vs. Expected Process – Architect.

Cost Summary - Architect								
Hybrid Expected Savings % Savings								
OmniClass Project Phase	Process	Process		by Role				
LCie 01 - Facility Criteria	-	-	-	0%				
LCie 02 - Design Specification	-	-	-	0%				
LCie 03 - Feasibility Study	\$10.00	\$10.00	-	0%				
LCie 04 - Project Definition	-	-	=	0%				

LCie 05 - Space Program	\$450.00	\$10.00	\$440.00	98%
LCie 06 - Product Program	\$640.00	\$10.00	\$630.00	98%
LCie 07 - Request for Proposal	\$70.00	\$70.00	-	0%
LCie 08 - Design Early	\$9,300.00	\$200.00	\$9,100.00	98%
LCie 09 - Design Schematic	\$24,100.00	\$1,300.00	\$22,800.00	95%
LCie 10 -Design Coordinated	\$57,300.00	\$7,300.00	\$50,000.00	87%
LCie 11 - Design Final	\$28,000.00	\$1,900.00	\$26,100.00	93%
LCie 12 - Request for Proposal	ı	ı	ı	0%
LCie 13 - Inquiry Issue	\$40.00	\$40.00		0%
LCie 14 - Pre-Construction Plan		1		0%
LCie 15 - Inquiry Issue (RFI)	\$1,900.00	\$200.00	\$1,700.00	89%
LCie 16 - Product Type Selection	ı	ı	ı	0%
LCie 17 - System Layout	-	-	-	0%
LCie 18 - Submittal Package	\$4,500.00	1	\$4,500.00	100%
LCie 19 - Submittal Issue	\$53,700.00	\$400.00	\$53,300.00	99%
LCie 20 - Purchase Order	-	1	1	0%
LCie 21 - Product Installation	\$40.00	ı	\$40.00	100%
LCie 22 - Start-Up	ı	ı	ı	0%
LCie 23 - Product Inspection	\$326,700.00	\$13,100.00	\$313,600.00	96%
LCie 24 - Punchlist Issue		1		0%
LCie 25 - Turnover Package		ı		0%
Total	\$506,800.00	\$24,500.00	\$482,200.00	95%

Table 16. Transit Station cost summary - Hybrid Process vs. Expected Process - Contractor.

Cost Summary - Contractor								
OmniClass Project Phase	Hybrid Process	Expected Process	Savings	% Savings by Role				
LCie 01 - Facility Criteria	-	-	-	0%				
LCie 02 - Design Specification	-	-	-	0%				
LCie 03 - Feasibility Study	-	-	-	0%				
LCie 04 - Project Definition	-	-	-	0%				
LCie 05 - Space Program	-	-	-	0%				
LCie 06 - Product Program	-	-	-	0%				
LCie 07 - Request for Proposal	-	-	-	0%				
LCie 08 - Design Early	-	-	-	0%				
LCie 09 - Design Schematic	-	-	-	0%				
LCie 10 -Design Coordinated	-	-	-	0%				
LCie 11 - Design Final	-	-	-	0%				
LCie 12 - Request for Proposal	-	-	-	0%				
LCie 13 - Inquiry Issue	\$20.00	\$20.00	-	0%				
LCie 14 - Pre-Construction Plan	-	-	-	0%				
LCie 15 - Inquiry Issue (RFI)	\$1,200.00	\$100.00	\$1,100.00	92%				
LCie 16 - Product Type Selection	-	-	-	0%				
LCie 17 - System Layout	-	-	-	0%				
LCie 18 - Submittal Package	\$21,600.00	\$1,700.00	\$19,900.00	92%				
LCie 19 - Submittal Issue	\$7,680.00	\$40.00	\$7,640.00	99%				
LCie 20 - Purchase Order	-	-	-	0%				
LCie 21 - Product Installation	\$12,900.00	-	\$12,900.00	100%				
LCie 22 - Start-Up	-	-	-	0%				
LCie 23 - Product Inspection	\$20.00	-	\$20.00	100%				
LCie 24 - Punchlist Issue			-	0%				
LCie 25 - Turnover Package	\$15,100.00	\$100.00	\$15,000.00	99%				
Total	\$92,300.00	\$12,300.00	\$80,100.00	87%				

This chapter illustrates Calculator results for the project types based on cost assumptions defined in Appendix E. The Transit Station program is of particular interest because the majority of cost assumptions for the 'Hybrid' approach are derived from actual project data. The comparison of Current vs. Hybrid shows the cost savings associated with the move to electronic communications within a managed project collaboration system but not the total elimination of paper copies. This is the actual approach taken by much of the industry. The Hybrid vs. Expected analysis shows the additional savings that could be realized by a transition to structured data exchanges in a totally paperless environment.

7 Short Form of the COBie Calculator

The Short Form of the COBie Calculator requires only 23 input variables, referred to as scaling variables, rather than 210. These variables define the size and complexity of the project and are used to scale the variables on the Current Assumptions tab. Of these 23 variables, only 3 new variables have been introduced. These are:

- Number of Floors/Levels
- Number of 1/8" = 1' 0" Plan Drawings per Sheet
- Number of Design Disciplines.

In addition, the Short Form allows the user to adjust the Reduction factors for activities that are eliminated, automated, or streamlined.

7.1 General overview

The Short Form COBie Calculator includes 1 additional tab — Short Form Variables.

To use the Calculator:

- 1. Enter project values for scaling variables and reduction factors into the Short Form Variables tab.
- 2. View overall savings and savings by role on Project Summary tab.
- 3. View cost and savings detail on relevant LCie process tabs.
- 4. To fine tune results, use override fields on the Current Assumptions Tab.

7.2 Detailed description

7.2.1 Introduction

The Short Form of the COBie Calculator is similar to the Full Version of the COBie Calculator. The only changes are:

- Addition of a new tab- Short Form Variables
- Addition of 3 new columns-Short Form Value, Override Value, and Final Value- on the Current Assumptions Tab

See Chapter 5 for information on all other tabs.

7.2.2 Short Form Variables tab

The variables in Short Form Variables tab are organized into the following categories:

- Scaling Variables
- Reduction Factors

The 23 scaling variables are:

Estimated Number of Pages in Facility Criteria: Estimated number of pages in Owner's initial analysis of Project need and Scope

Estimated Number of Pages in Discipline Specification: Estimated number of pages in Equipment performance requirements provided during planning

Estimated Number of Pages in Project Definition: Estimated number of pages in Project Definition document. The Project Definition defines the project scope, budget requirements, site details, economic analysis and facility planning data

Estimated Number of Pages in Front Matter: Estimated number of pages that precede the technical content of the RFP for Design Services and Construction Services.

Number of Space Types per Project: Number of space types (by function) found in each project

Number of Unique Product Types: Number of different product types that will be installed.

Number of Tagged Components: Total number of pieces of equipment that will have asset tags and will be managed by the owner

Pre-Design Submittal Sets Reqd.: Number of pre-design drawing sets required for each submittal.

Estimated Number of Sheets per Option: Estimated number of drawing sheets included in each project option in the feasibility study.

Estimated Number of Letter Sized Pages in Pre-Design Narrative per Option: Estimated number of pages included in the pre-design narrative per project option in the feasibility study.

Number of Design Submittal Sets Reqd.: Number of Design Phase drawing sets required

Estimated Number of Letter- Sized Pages in Design Narrative: Estimated number of pages in the design narrative for each design review

Estimated Number of Letter Sized Pages in Specification: Estimated number of pages in the Specification document

Number of Submittal Sets Reqd.: Number of construction phase submittal sets required

Estimated Number of Letter Sized Pages in Proposal: Estimated number of Letter-Sized Pages in the Architect's response to the Owner's Request for Proposal

Estimated Number of Drawing Sheets in Proposal: Estimated number of sheets included in the Architect's response to the Owner's Request for Proposal

Number of RFP copies Reqd.: Number of RFP sets required

Avg. Number of Months of Construction: Average construction duration of a project

Number of Floors / **Levels:** Number of floors within each project

Number of 1/8" = 1' 0" Plan Drawings per Sheet: Number of 1/8" = 1' 0" floor plans on a drawing sheet

Number of Design Disciplines: Architectural, Structural, Mechanical, Electrical etc

Small Printer – Letter Sized Pages: Number of Letter Sized Pages printed per minute

Large Printer – E1 Size Sheets: Number of Sheets printed per minute

The default values for the Scaling Variables are set to "0", requiring the user to input data for the variables. Values for the Reduction Factors in this tab are pre-populated but can be altered by the end user.

Based on the values supplied by the user, the following tabs are populated automatically: Current Assumptions, Expected Assumptions, Project Summary and the LCie tabs.

7.2.3 Current Assumptions tab

The Short Form of the COBie Calculator introduces 3 new columns on the Current Assumptions tab: Short Form Value, Override Value, and Final Value.

The Short Form Value column contains some values directly transferred from the Short Form Variables sheet. These are shown in red. Other values are calculated by the Short Form COBie Calculator. The assumptions used in these calculations are documented in Appendix F.

If a user decides the value found in the Short Form Value column is inaccurate, he/she may override that value by providing a new value in the Override Value column. The default value for the Override Value column is "N/A". The Final Value column displays the value that will be used in performing the calculations for each variable.

In summary, the Short Form of the COBie Calculator requires user input of only 23 values. The LCie worksheets are then automatically populated based on the assumptions found in Appendix F to determine current and expected costs.

7.3 Testing the Short Form of the COBie Calculator

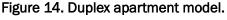
To test the Short Form of the COBie Calculator, the results generated for a program using the Short Form Calculator were compared to the results generated using the Long Form of the COBie Calculator. To do this, the

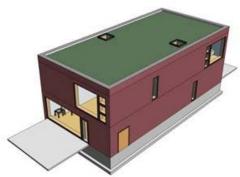
Duplex Apartment Experimental BIM model, mentioned in Chapter 6 was used.

The Duplex Apartment model, seen in Figure 14, is a two-story, two unit apartment building. Listed below are the overall building statistics:

• Size: 3,372 SF

of Product Types: 43# of Components: 232





It was assumed that a military base was developing a residential program comprised of 100 Duplex units.

Table 17 below shows the Overall cost and cost savings results of the Long Form of the Calculator, while Table 18 shows the results from the Short Form of the Calculator.

Cost Summary								
OmniClass Project Phase (Table31)	Current Process	Expected Process	Savings	% Savings				
LCie 01 - Facility Criteria	-	-	-	0%				
LCie 02 - Design Specification	\$15.00	=	\$15.00	100%				
LCie 03 - Feasibility Study	\$470.00	\$20.00	\$450.00	96%				
LCie 04 - Project Definition	-	=	•	0%				
LCie 05 - Space Program	\$550.00	\$10.00	\$540.00	98%				
LCie 06 - Product Program	\$660.00	\$5.00	\$655.00	99%				
LCie 07 - Request for Proposal	\$400.00	\$100.00	\$300.00	75%				
LCie 08 - Design Early	\$3,430.00	\$30.00	\$3,400.00	99%				
LCie 09 - Design Schematic	\$4,500.00	\$400.00	\$4,100.00	91%				
LCie 10 -Design Coordinated	\$18,300.00	\$3,400.00	\$14,900.00	81%				
LCie 11 - Design Final	\$7,000.00	\$500.00	\$6,500.00	93%				
LCie 12 - Request for Proposal	\$490.00	\$30.00	\$460.00	94%				
LCie 13 - Inquiry Issue	\$1,210.00	\$30.00	\$1,180.00	98%				

Table 17. Long Form Duplex cost summary.

LCie 14 - Pre-Construction Plan	-	-	-	0%
LCie 15 - Inquiry Issue (RFI)	\$5,000.00	-	\$5,000.00	100%
LCie 16 - Product Type Selection	T	ı	-	0%
LCie 17 - System Layout	T	T	-	0%
LCie 18 - Submittal Package	\$12,200.00	\$600.00	\$11,600.00	95%
LCie 19 - Submittal Issue	\$56,300.00	\$400.00	\$55,900.00	99%
LCie 20 - Purchase Order	-	-	-	0%
LCie 21 - Product Installation	\$278,300.00	-	\$278,300.00	100%
LCie 22 - Start-Up	-	ı	-	0%
LCie 23 - Product Inspection	\$15,900.00	\$600.00	\$15,300.00	96%
LCie 24 - Punchlist Issue	-	-	-	0%
LCie 25 - Turnover Package	\$27,400.00	\$100.00	\$27,300.00	99%
Total	\$432,000.00	\$6,000.00	\$426,000.00	99%

Table 18. Short Form of Duplex cost summary.

Cost Summary							
OmniClass Project Phase (Table31)	Current Process	Expected Process	Savings	% Savings			
LCie 01 - Facility Criteria	=	•	-	0%			
LCie 02 - Design Specification	\$20.00	•	\$20.00	100%			
LCie 03 - Feasibility Study	\$470.00	\$20.00	\$450.00	96%			
LCie 04 - Project Definition	-	ı	-	0%			
LCie 05 - Space Program	\$510.00	\$10.00	\$500.00	98%			
LCie 06 - Product Program	\$540.00	\$20.00	\$520.00	96%			
LCie 07 - Request for Proposal	\$400.00	\$100.00	\$300.00	75%			
LCie 08 - Design Early	\$4,900.00	\$100.00	\$4,800.00	98%			
LCie 09 - Design Schematic	\$7,100.00	\$700.00	\$6,400.00	90%			
LCie 10 -Design Coordinated	\$21,600.00	\$3,700.00	\$17,900.00	83%			
LCie 11 - Design Final	\$9,200.00	\$800.00	\$8,400.00	91%			
LCie 12 - Request for Proposal	\$410.00	\$30.00	\$380.00	93%			
LCie 13 - Inquiry Issue	\$1,210.00	\$30.00	\$1,180.00	98%			
LCie 14 - Pre-Construction Plan	-	-	-	0%			
LCie 15 - Inquiry Issue (RFI)	\$4,700.00	ı	\$4,700.00	100%			
LCie 16 - Product Type Selection	-	ı	-	0%			
LCie 17 - System Layout	-	-	-	0%			
LCie 18 - Submittal Package	\$12,200.00	\$600.00	\$11,600.00	95%			
LCie 19 - Submittal Issue	\$60,500.00	\$400.00	\$60,100.00	99.3%			
LCie 20 - Purchase Order	-	-	-	0%			
LCie 21 - Product Installation	\$278,300.00	-	\$278,300.00	100%			
LCie 22 - Start-Up	-	-	-	0%			
LCie 23 - Product Inspection	\$15,900.00	\$600.00	\$15,300.00	96%			
LCie 24 - Punchlist Issue	-	-	-	0%			
LCie 25 - Turnover Package	\$27,400.00	\$100.00	\$27,300.00	99%			
Total	\$445,000.00	\$7,000.00	\$438,000.00	98%			

The results show a 3% deviation between the Long Form of the Calculator and the Short Form of the Calculator. This demonstrates that the Short Form of the Calculator provides comparable results, even though only 23 Scaling Variables are used instead of the 210 variables found in the Long Form of the Calculator.

8 Program Analysis

The Program Analysis Form of the Calculator is designed for use by organizations that have capital programs comprised of multiple project types. Examples would include developers that have both residential and commercial projects, and universities with projects that vary from dormitories and laboratories to sports facilities. The Program Analysis template is designed to analyze up to 3 project types but can be extended by the user.

The Program Analysis Form of the Calculator is based on the Short Form of the Calculator discussed in Chapter 7. The Program Analysis Form requires 24 input variables for each project type. These variables define the size and complexity of each project type and are used to scale the variables on the Current Assumptions tab.

Twenty-three of these variables are the same as those in the Short Form and are described in Chapter 7. One additional variable is introduced:

Number of Projects: Estimated number of projects of similar type, size, and complexity in the capital program

Like the Short Form, the Program Form allows the user to adjust the Reduction factors for activities that are eliminated, automated, or streamlined.

8.1 General overview

The Program Analysis template for the COBie Calculator adds 53 tabs to the original Long Form of the COBie Calculator:

- Program Short Form Variables
- Project Type Summary
- Program Summary
- 50 additional Life Cycle information exchange (LCie) Processes (25 to represent PT_B and 25 to represent PT_C)

The Program Analysis template also adds columns to the following tabs:

Program Short Form Variables

- Based on Short Form Variables Tab
- Provides a separate column for variables and reduction factors for each project type

Figure 15. Program Short Form Variables tab.

Variables	Value					
variables	PROJECT TYPE A	PROJECT TYPE B	PROJECT TYPE C]		
Program Variables						
Number of Projects	5	4	3	pr		
Scaling Variables				H		
Estimated Number of Pages in Facility Criteria	2	14	20	pa		
Estimated Number of Pages in Discipline Specification	43	400	549	pa		

- Current Assumptions Tab
 - o Similar to Short Form Current Assumptions Tab
 - o Provides 3 columns for each project type
 - Short Form Value
 - Override Value
 - Final Value

Figure 16. Current Assumptions tab.

Inputs NOTE: Red text indicates			Va	lue					
variables populated based on values from Scaling Variables from Short Form Variables Tab	PROJECT TYPE A PROJECT TYPE B			PF	PROJECT TYPE C				
	Short Form Value	Override Value	Final Value	Short Form Value	Override Value	Final Value	Short Form Value	Override Value	Final Value
Owner Project / Program Variables									
Avg. Number of Pages in Facility Criteria	2	N/A	2	14	N/A	14	2	N/A	2
Avg. Number of Pages in Discipline Specification	52	N/A	52	400	N/A	400	52	N/A	52
Avg. Number of Pages in Project Definition	2	N/A	2	14	N/A	14	2	N/A	2

- Expected Assumptions Tab
 - Similar to Short Form Expected Assumptions Tab
 - Provides spate Current Value and Expected Value columns for each project type

Current Value Expected Outcome Inputs NOTE: Red text indicates variables Reduction Unit PROJECT PROJECT PROJECT PROJECT PROJECT PROJECT affected by the expected process TYPE A TYPE B TYPE C TYPE A TYPE B TYPE C Number of Space Types per Project 18 30 space types 18.00 30.00 18.00 / building Number of Unique Product Types (Types / 53 155 53 types / 53.00 155.00 53.00 program) Number of Tagged Components (components project 3950 262 components 262.00 3950.00 262 262.00 / project 100% 0.25 0.25 0.25 0.00 0.00 0.00 Time to Log (hours / transmittal) hours / transmittal Pre-Design Variables Avg. Number of Options 3 3 3 3 00 3 00 count 3 00 Avg. Number of Pre-Design Submittal 4 4 4 sets/ 100% 0.00 0.00 0.00 Sets Reqd. (sets / submittal)

Figure 17. Expected Assumptions tab.

To use the Program Analysis Form of the Calculator:

- 1. Enter project values into Program Short Form Variables tab for each project type.
- 2. View total savings and total savings by role on the Program Summary tab.
- 3. View savings and savings by role for an individual project of each type on the Project Summary tab
- 4. View detailed costs and savings for each project type on the related LCie process tabs.
- 5. To fine tune results, use override fields on the Current Assumptions Tab.
- 6. To modify the Expected Value results, change the reduction factors on the Program Short Form Variables tab

8.2 Detailed description

8.2.1 Project Type Summary tab

The Project Type Summary tab shows the costs and cost savings for one of each project type and a breakdown of costs and cost savings by role i.e. Owner/Owner's Representative, Architect and Contractor.

8.2.2 Program Summary tab

The Program Summary tab reports total costs and cost savings for all projects of each type. It also provides a roll up report across all projects.

8.2.3 Life Cycle Information Exchange Process tabs

As opposed to having 25 LCie Process tabs, this version of the Calculator has 75 tabs. This allows each of the 3 project types to have its own set of LCie tabs and allows the end user to view cost savings for one of each project type independently of the others. The LCie tabs are labeled as follows: 010_Facility_Critera_PT A, 010_Facility_Criteria_PT B, 010_Facility_Critera_PT C, 020_Discipline_SpecificationPT A, 020_Discipline_SpecificationPT B, etc.

The end user should not make any changes or input data on the individual process tabs. All adjustments should be made on the Program Short Form Variables tab or the Current Assumptions tab where necessary.

8.2.4 User customization

The developed version of the Program Analysis Form of the Calculator allows for 3 different project types; however, a user or organization may require more than 3 project types to analyze their capital program. Below are the steps to take in order to expand the Calculator to include additional project types.

- 1. On the Program Short Form Variables tab, insert a new Project Type column under the Value subdivision for the new project type.
- 2. On the Current Assumptions tab, insert 3 new columns (Short Form Value, Override Value, and Final Value) for the new project type next to the existing project types. For each cell in these new columns, reference the appropriate value on the Program Short Form Variables tab using the existing project types as a guide.
- 3. On the Expected Assumptions tab, add a Current Value column and an Expected Outcome column for the new project type. For each cell in these new columns, reference the appropriate value on the Current Assumptions tab and/or Program Scaling Variables tab for the new project type using the existing project types as a guide.
- 4. Add a set of the LCie worksheets for the new project type. It is important that the names of the new LCie worksheets reflect the new project type (e.g. 010_Facility_Criteria_PT D). For each yellow or blue colored cell on the worksheet, reference the appropriate value on the Current Assumptions tab or the Expected Assumptions tab using the existing LCie worksheets as a guide.

- 5. On the Project Types Summary tab, add new Project Type Summary tables for the new project type. For each cell in these new tables, reference the appropriate LCie worksheet and value using the existing Project Type Summary tables as a guide.
- 6. On the Program Summary Tab, add a Program Summary for the new project type. For each cell in these new tables, reference the appropriate table and value using from the Project Types Summary tab using the existing Program Summary tables as a guide.
- 7. On the Program Summary Tab, update the Overall Summary table to accommodate the new project type, in the Total column of the Overall Summary table add a reference to the overall Total Program Cost row for the Current Process and Expected Process columns of the new project type to the Current Process Cost and Expected Process Cost rows respectively. Repeat this process for each of the 3 role types.

Note: The simplest way to perform the insertion and referencing for a column, worksheet, or table is to copy the necessary existing column, worksheet, or table from Project Type C and paste it into the correct location for the new project type. Then, highlight the newly inserted column, worksheet, or table and use the "Find and Replace" feature in Excel to replace the worksheet and/or cell references to Project Type C's data with the worksheet and/or cell references to the new project type's data. It is recommended that if a user or organization is adding a large number of new project types, an Excel macro is developed to automate the process.

In summary, the Program Analysis Form of the Calculator is useful for organizations that have a capital program with diverse project types. It allows for the summation of current and expected costs and savings across the entire capital program. While the Calculator is set up for 3 project types, users or organizations can expand the Calculator to include additional project types.

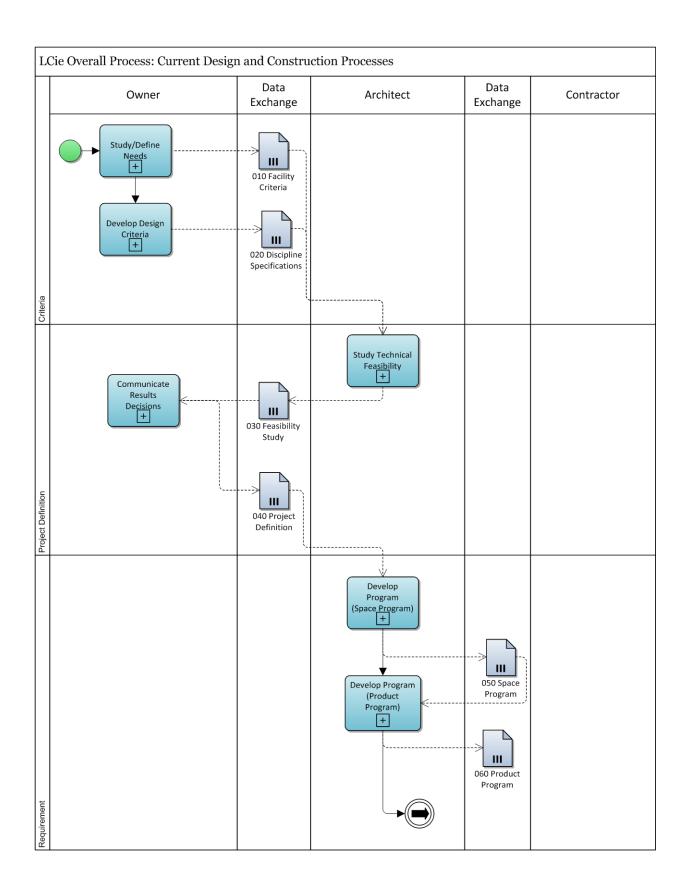
References

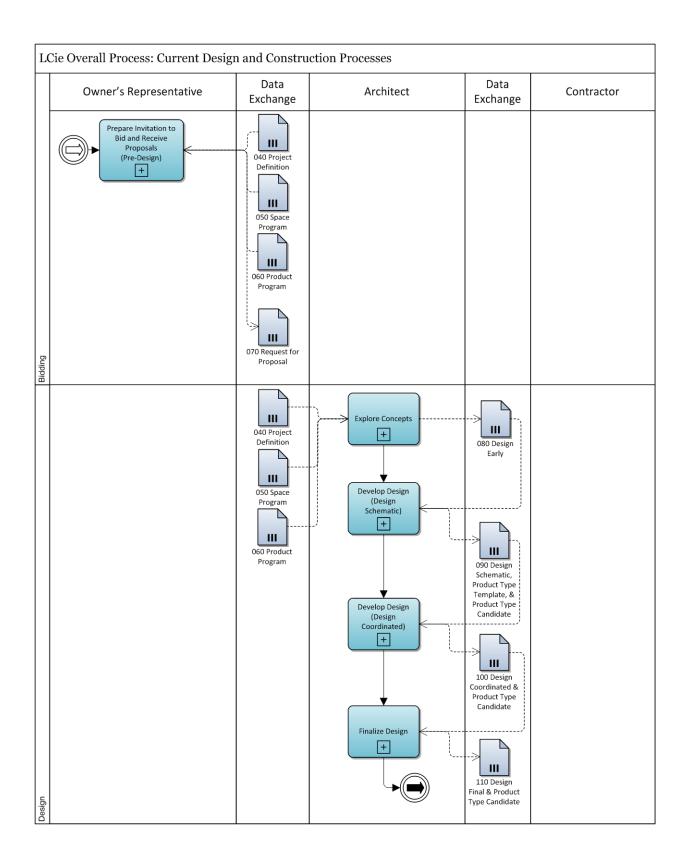
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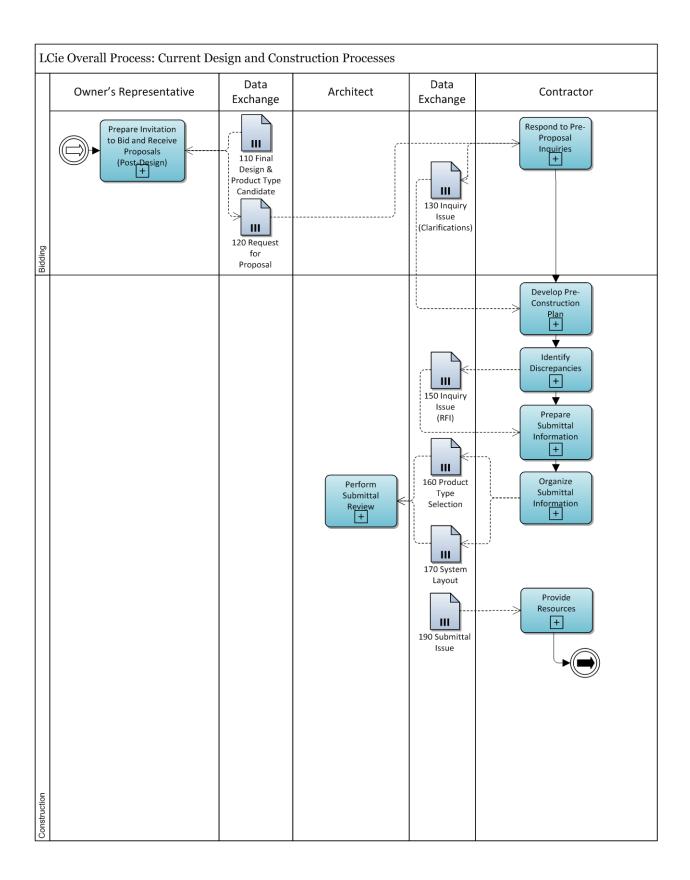
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Appendix A: Overall Process Map







Appendix B: Comparison of AIA/CSI MasterFormat and UFC/UFGS Submittal Requirements

	es es	Industry S	tandard (AIA B101-20	07)			Unified Facilities Criter	ria					
Lifecycle Phase	LCie Exchange	Section	Deliverable	Format	Number of Copies	Section	Deliverable	Format	Number of Copies				
Criteria, Initiation, Requirement	Discipline Specifications, Project Definition, Space Program, & Product Program					СН. 9	Predesign Submittal Requirements						
tiati						0.1	1391 with the following information	EPG	n/a				
II.						9.1	Detailed Scope	EPG	n/a				
ria,							Collateral equipment	EPG					
řite							list & cost	EPG	n/a				
							 Preliminary budgetary cost information for primary and supporting facilities 	EPG	n/a				
							•Site location and	EPG	n/a				
							approval • NEPA documents	EPG	n/a				
							• SHPO (as required)	EPG	n/a				
							• Economic Analysis	EPG	n/a				
							Facility Planning Data	EPG	n/a				
							• Project specific Data	EPG	n/a				
Design							Concept Design Submittal Requirements (10 -						
-	Design Early	B101-2007 3.2	Schematic Design			CH. 10.2	15%)						
		B101-2007 3.2.3	Feasibility Study	n/a	n/a	10-2.1	Basis of design narrative	electronic	n/a				
			Preliminary Design (2 - 3 Options)	n/a	n/a	10-2.2	Concept Design Documents	electronic	n/a				
		B101-2007 3.2.4 B101-2007 3.2.5	Schematic Design (Approved preliminary design)	n/a	n/a	10-2.2	Documents	electronic	11/ d				
		5.01-2007 3.2.3	• Site Plan	n/a	n/a		• Site Plan	electronic	n/a				
			Building Plans	n/a	n/a		Building Plans	electronic	n/a				
			Building Sections	n/a	n/a		Building Sections	electronic	n/a				
			• Elevations	n/a	n/a		 Single line diagram (electrical) 	electronic	n/a				
			Preliminary selection of building materials	n/a	n/a		Building Elevations	electronic	n/a				
			Preliminary selection of building	n/a	n/a		<u> </u>						
1		B101-2007 3.2.6	systems • Estimate of the Cost	n/a	n/a	10-1.4	• Life safety floor plan Cost Estimate	electronic electronic	n/a n/a				
			of the Work			10-2.3	Calculations	alactro=!:	n/a				
						10-2.3	Calculations	electronic	11/ d				
	Design Schematic	B101-2007 3.3	Design Development			СН. 10.3	Design Development Submittal Requirements (35 - 50%)						
		B101-2007 3.3.1	Design Development Documents (approved schematic design)	n/a	n/a	10-3.1	Basis of design narrative	electronic	n/a				
						10.00	Design Development	alasto t	- /				
			• Site Plan	n/a	n/a	10-3.2	Documents • Site Plan	electronic electronic	n/a n/a				
			Building Plans	n/a	n/a n/a	10-3.2.1	• Floor Plans	electronic	n/a n/a				
			Ŭ				• Roof Plan	electronic	n/a				
			• Elevations	n/a	n/a		Building Elevations	electronic	n/a				
			• Sections	n/a	n/a		Building Sections	electronic	n/a				
			• Typical Construction Details	n/a	n/a		• Typical Wall Sections	electronic	n/a				
				n/a	n/a		Typical Wall Sections	electronic	n/a				

	e)	Industry S	tandard (AIA B101-20	Unified Facilities Criter	ified Facilities Criteria				
Lifecycle Phase	LCie Exchange	Section	Deliverable	Format	Number of Copies	Section	Deliverable	Format	Number of Copies
			Diagrammatic layout of building systems	n/a	n/a		• Finish Schedule	electronic	n/a
			Outline specifications that identify major materials & systems and establish in general their	n/a	n/a				
			quality levels.				• Furniture Plan	electronic	n/a
		B101-2007 3.3.2	 Estimate of the Cost of the Work 	n/a	n/a	10-3.2.2	 Landscape planting plan 	electronic	n/a
							 Plant schedule and details 	electronic	n/a
							• Irrigation Plan &		
						10-3.2.3	Details • Utility Plan	electronic electronic	n/a n/a
						10-3.2.3	• Layout Plan	electronic	n/a
							•		
						10-3.2.4	• Foundation Plans	electronic	n/a
							Framing Plans Structural Details	electronic electronic	n/a n/a
							Structural Details Structural Elevations	electronic	n/a
						10-3.2.5	• Plumbing Floor Plan	electronic	n/a
							• HVAC Floor Plan	electronic	n/a
							• Mechanical room Plan	electronic	n/a
						10-3.2.6	• Lighting Plans	electronic	n/a
							• Power Plans	electronic	n/a
							• Lightning Protection Plans	electronic	n/a
							• Cathodic Protection Plans	electronic	n/a
							Special Systems Plans Single Line Diagrams Plans	electronic electronic	n/a n/a
							• Additional Plans/risers	electronic	n/a
						10-3.2.7	• Life Safety Plan	electronic	n/a
							• Fire Suppression plans	electronic	n/a
							 Fire Alarm and Mass Notification System Plans 	electronic	n/a
						10-3.2.8	Geotechnical report	electronic	n/a
						10-3.3	Outline Specification	electronic	n/a
						10-3.4	Color Boards Calculations	electronic	n/a
						10-3.5 10-3.5.3.4	Calculations	electronic	n/a
							ASHRAE 90.1		
						10-3.5.1	compliance calculations Energy Analysis	electronic electronic	n/a n/a
						10-3.5.2	Life Cycle Cost Analysis	electronic	n/a
						10-3.5.3	Building Heating & Cooling Load	electronic	n/a
						10-3.6	Environmental Report	electronic	n/a
	Design						Pre-Final Design	electronic	n/a
	Coordinated					10.4	Submittals (100%)		n/a
						10-4.1	Basis of design narrative Pre-Final Design	electronic	n/a
							Documents (in addition to drawings indicated in Design		
						10-4.2	Development)	electronic	n/a
						10-4.2.1	• Lighting Details	electronic	n/a
							• Power Details	electronic	n/a

	6)	Industry S	tandard (AIA B101-20	07)				Unified Facilities Criter	ia	
Lifecycle Phase	LCie Exchange	Section	Section Deliverable		Number of	Copies	Section	Deliverable	Format	Number of Copies
				•	•	-		 Power Single Line Diagram Telephone Riser 	electronic	n/a
								Diagram	electronic	n/a
						_		 Intercommunication Riser Diagram Intercommunication 	electronic	n/a
						-		Riser Diagram • Fire Alarm Riser	electronic	n/a
								Diagram	electronic	n/a
								• Panel Schedules	electronic	n/a
								 Switchboard and Motor control Center schedules 	electronic	n/a
								 Lighting Fixture Details 	electronic	n/a
						-	10-4.3	Specifications	electronic	n/a
						ŀ		Submittal Register	electronic	n/a
							10-4.4	Project Information Form (PIF)	electronic	n/a
						-	10-4.5	Color Boards	electronic	n/a
				_	1		10-4.6	Calculations	electronic	n/a
	Design Final		Construction							
	2 congri i i i i i	B101-2007 3.4	Documents				10.5	Final Design Submittal		
		B101-2007 3.4.1	Construction Documents (approved schematic design)	n/a	n	/a		All items from previous submittal plus the following:		
			• Site Plan	n/a	n/	/a	10-5.2.2	Quality Control Data	electronic	n/a
			• Building Plans	n/a	n/	/a	10-5.5	Color documentation binder	electronic	n/a
			• Enlarged Plans	n/a		/a	10-5.8.1	Code compliance certification		n/a
			• Sections • Elevations	n/a n/a	 	/a /a				
			• Typical Construction Details	n/a		/ a				
			Diagrammatic layout of building systems	n/a	n/	/a				
			• Complete specifications	n/a	n/	/a				
		B101-2007 3.4.4	Estimate of the Cost of the Work	n/a	n/	/a			<u> </u>	
				-		_				
Bidding	Inquiry Issue	B101-2007 3.5	Bidding or Negotiation				11	Pre-Proposal/Pre-Bid Inquiries		
Bid		B101-2007 3.5.2.2	Procure reproduction of bidding documents	n/a	n/	/a		DODida		
		B101-2007 3.5.2.3	Prepare & distribute addenda	n/a	n/	/a	11.2	DOR provides response to PP/PBI or RFI		

se	95	Ind	ustry Standard (CSI M	MasterSpec	2004)	Unifi	ed Facilities Guide Speci	fications (UFGS)		
Construction Lifecycle Phase	LCie Exchange	Section	Deliverable	Format	Number of Copies	Section	Deliverable	Format	Number of Copies	
truction	Product Type Selection	013300	Submittal Schedule	Paper or Electronic in PDF file format	3 - Paper, 1 - Electronic	01 33 00	SD-01 Preconstruction Submittals		3	
Cons			Product Data	Paper or Electronic in PDF file format	3 - Paper, 1 - Electronic		Certificates of insurance			
			Shop Drawings	Paper or Electronic in PDF file format	3 - Paper, 1 - Electronic		Surety Bonds			
			Samples	Physical	3		List of proposed subcontractors			
			Product Schedule	Paper or Electronic in PDF file format	3 - Paper, 1 - Electronic		List of proposed producers			
			Reports	Paper or Electronic in PDF file format	3 - Paper, 1 - Electronic		Construction Progress Schedule			
			Certificates	Paper or Electronic in PDF file format	3 - Paper, 1 - Electronic		Network Analysis Schedule			
				TOTTING			Submittal Register	Electronic		
							Schedule of Prices Health and Safety Plan			
							Work Plan			
							Quality Control Plan Environmental			
							Protection Plan			
						01 33 00 01 33 00	SD-02 Shop Drawings		7	
						01 33 00	SD-03 Product Data SD-04 Samples		2	
						01 33 00	SD-05 Design Data		7	
						01 33 00	SD-06 Test Reports	-	7	
						01 33 00	SD-07 Certificates SD-08 Manufacturer's			
						01 33 00	Instructions		7	
						01 33 00	SD-09 Manufacturer's Field		7	
							Reports SD-10 Operation and			
						01 33 00	Maintenance Data		3	
		017839	Record Drawings	Paper, PDF, or CAD file format	3 paper or 1 PDF and 3 paper or 1 CAD and 3 paper	01 33 00/ 01 78 00	SD-11 Closeout Submittals		3	
			Record Specifications	Paper or Electronic in PDF file format	1 paper or 1 PDF file	01 78 00	Record/As-Built Drawings	Electronic or Paper	2 paper sets, 1 electronic in CAD	
						01 78 00	Final Approved Shop Drawings	Electronic or Paper	1 electronic in CAD	
						01 78 00	As-Built Construction Contract Specifications	Paper	2 Paper sets	
			Record Product Data	Paper or Electronic in PDF file format	1 paper or 1 PDF file	01 78 00	Final DD Form 1354	Electronic	1	
			Miscellaneous Record Submittals	Paper or Electronic in PDF file format	1 paper or 1 PDF file	01 78 00	Certification of EPA Designated Items			
		017700	Warranties	Paper or Electronic in PDF	1 paper copy or 1 paper and 1 PDF file	01 78 00	Warranty Management Plan	Not specified	1	
						01 78 00	Warranty Tags	Donon O	2	
						01 78 00	Operations and Maintenance Manuals	Paper, 3- ring Binders	7	
								2		

se	ege -	Ind	ustry Standard (CSI M	l asterSpec	2004)	Unifi	ications (U	s (UFGS)	
Lifecycle Phase	LCie Exchange	Section	Deliverable	Format	Number of Copies	Section	Deliverable	Format	Number of Copies
	System Layout					01 33 00	Detail Shop Drawings	Paper	7
						23 00 00	Detail Shop Drawings	N/A	N/A
	Product Installation	12900	Schedule of Values on AIA G703	Paper	3	01 20 00. 00 20/ 01 45 00.10 10	Earned Value Report	Electronic/P aper	1 Electronic, 1 Paper
		12900	Liens	Paper	3	01 20 00. 00 20/ 01 45 00.10 10	Interim DD Form 1354	Electronic/P aper	1 Electronic, 1 Paper
		12900	Waivers	Paper	3	01 20 00. 00 20/ 01 45 00.10 10	Contractor's Invoice	Electronic/P aper	1 Electronic, 1 Paper
						01 20 00. 00 20/ 01 45 00.10 10	Updated Project Schedule	Electronic/P aper	1 Electronic, 1 Paper
						01 20 00. 00 20/ 01 45 00.10 10	Submittal Register	Electronic/P aper	1 Electronic, 1 Paper
						01 20 00. 00 20/ 01 45 00.10 10	Contractor Safety Self Evaluation Checklist	Electronic/P aper	1 Electronic, 1 Paper
						01 78 00	Record/As-Built Drawings	Electronic/P aper	2 paper sets, 1 electronic
						01 78 00	Final Approved Shop Drawings	Paper	1
						01 78 00	As-Built Construction Contract Specifications	Paper	2
	Product Inspection	1770	Punchlist	Paper or Electronic (PDF or MS Excel)	3 paper or 1 electronic file	01 45 00.00 10	Quality Control Plan	Not specified	3
		-					Punch Lists QA/QC Comments	Electronic Electronic	N/A N/A
							Three Control Phase	Electronic	N/A
		-				01 45	Checklist	Not	7
						00.00 40	Test Reports	specified Not	7
		-					Quality Control Data Quality Control	specified Not	
							Coordinating Actions	specified Not	7
							Quality Control Training	specified	7
							Inspection Records	Not specified	7
							Letters of Authority or Delegation	Not specified	7
							Field Tests	Not specified	7
							Factory Tests	Not specified	7
						01 45 00.00 40	Quality Assurance Plan		7
						01 45 00.00 40	Contractor's Quality Representative		
						01 45 00.00 40	Qualifications Special Certifications		
	Punchlist Issue	-				01 45 00.10 10	Nonconformance Issues	Electronic	N/A
						01 45 00.10	Deficiency Lists	Electronic	N/A
						10 01 45 00.10 10	Correspondence to the Owner	Electronic	N/A
						01 45 00.10 10	Requests for Information	Electronic	N/A

Appendix C: Current and Expected LCie Process Maps

This appendix contains the LCie workflows for the Current and Expected Processes. Each business process diagram contains the Current Process workflow overlaid by the Expected Process workflow. Where tasks were eliminated, automated, or streamlined in the Expected Process, the task box was color-coded according to the following legend:

- Eliminated Tasks
 - Liminacca Tasks
- Automated Tasks

Streamlined Tasks

- Unchanged Tasks from Current LCie Process

LCie Process: Study / Define Needs | LCie Exchange: 010 Facility Criteria Data Owner Architect Contractor Exchange Exchange 010.01 Identify Need Does Facility Type Criteria Exist? Yes Has it Been Updated in 5 years? No 010.02.10 Review Existing Facility Criteria 010.02.20 010.02.30 Appoint Criteria Produce Facility Criteria Team 010.02.40 Copy Facility Criteria Ш Facility Criteria LEGEND Eliminated Tasks Automated Tasks Streamlined Tasks

Figure 18. Study/define needs.

LCie Process: Develop Design Criteria | LCie Exchange: 020 Discipline Specifications Data Data Owner Architect Contractor Exchange Exchange 020.01 Identify Need Does a Discipline Specification Exist? Has it Been Updated in 5 020.02.10 Review Existing 020.02.20 Develop Discipline Specification Discipline Specification 020.02.30 Produce Discipline Specification 020.02.40 Copy Discipline Specification Ш Specification **LEGEND** Eliminated Tasks Automated Tasks Streamlined Tasks

Figure 19. Develop design criteria.

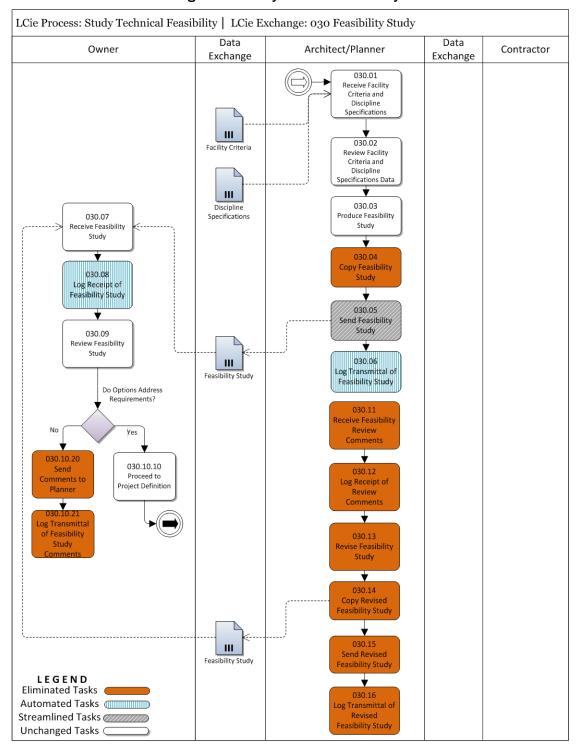


Figure 20. Study technical feasibility.

LCie Process: Communicate Results Decisions | LCie Exchange: 040 Project Definition Data Data Owner Architect/Planner Contractor Exchange Exchange 040.01 Review Information for Facility Criteria, Discipline Specifications, and Feasibility Study 040.02 Evaluate Total Risk Proceed with Detailed Scope Preliminary budgetary cost information Site location & approval Economic analysis 040.03.20 040.03.10 Facility Planning Data **End Project** Produce Project Facility Criteria Discipline Specification Feasibility Study Planning Definition 040.03.30 Copy Project Definition Ш Project Definition LEGEND Eliminated Tasks Automated Tasks Streamlined Tasks Unchanged Tasks 🤇

Figure 21. Communicate results decisions.

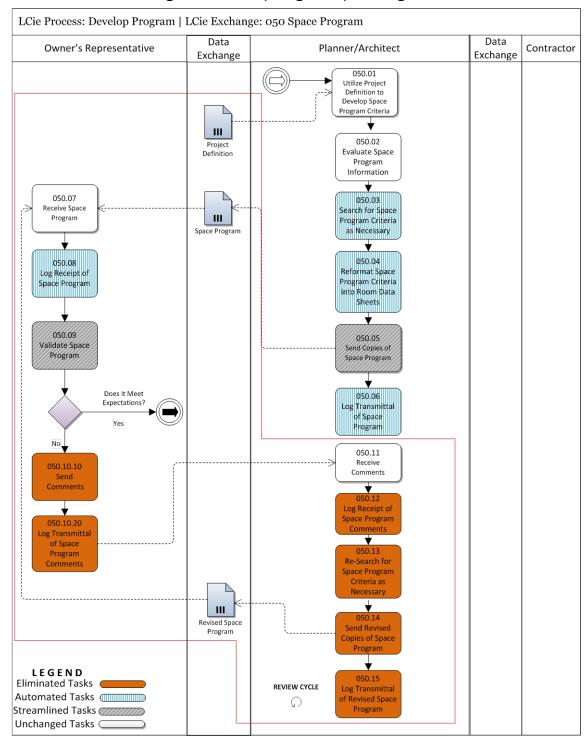


Figure 22. Develop Program-Space Program.

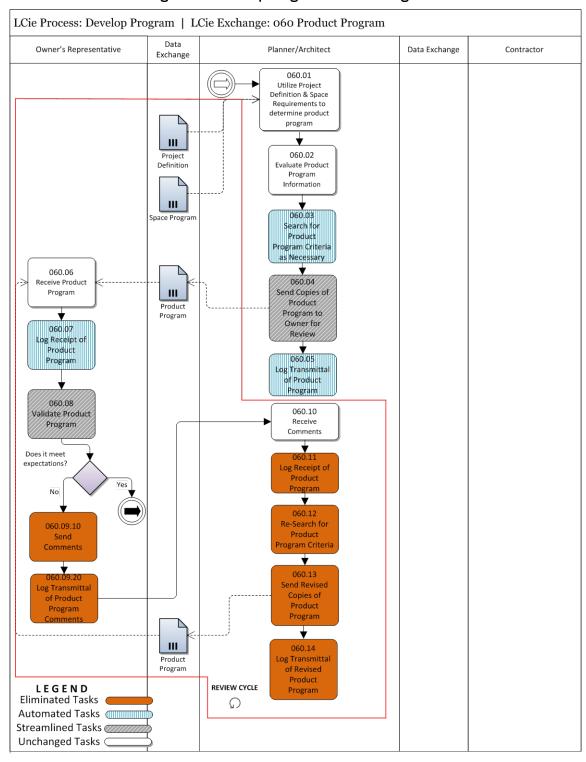


Figure 23. Develop Program- Product Program.

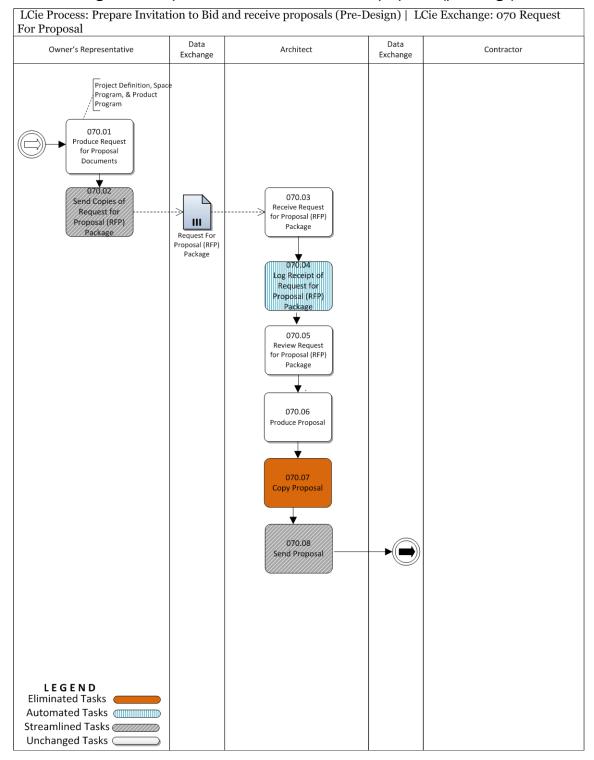


Figure 24. Prepare invitation to bid and receive proposals (pre-design).

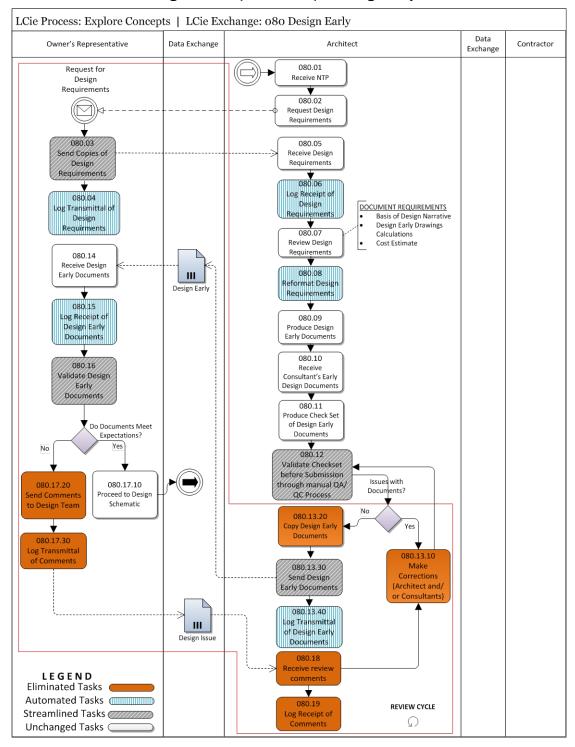


Figure 25. Explore Concepts- Design Early.

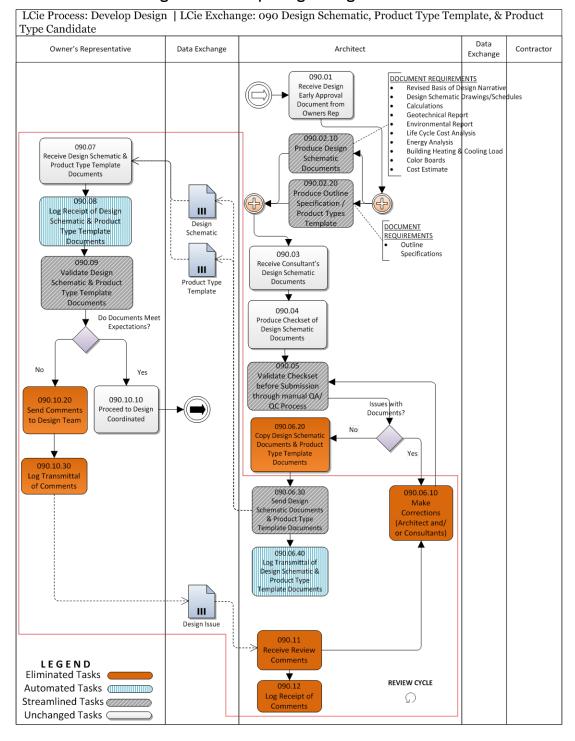


Figure 26. Develop Design- Design Schematic.

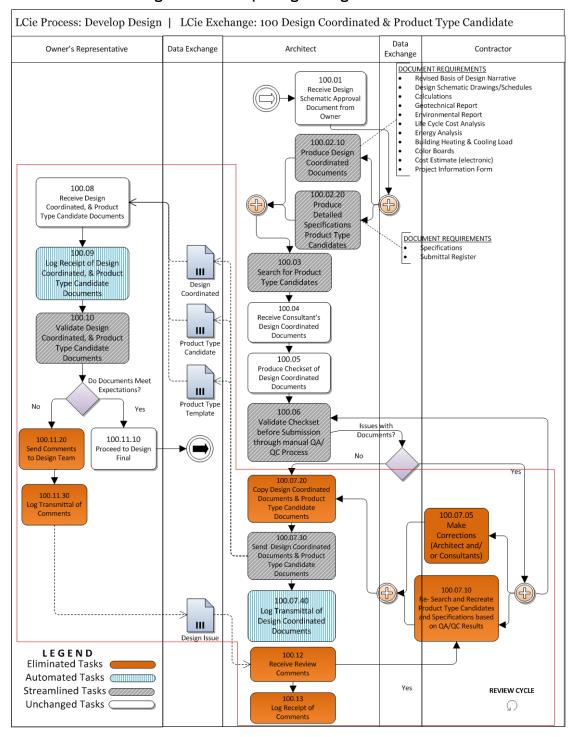


Figure 27. Develop Design- Design Coordinated.

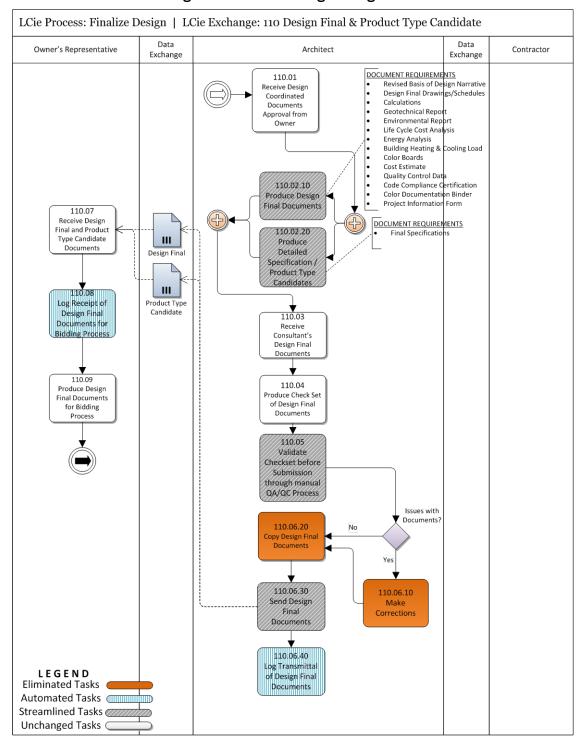


Figure 28. Finalize Design-Design Final.

LCie Process: Prepare Invitation to Bid and receive proposals (Post-Design) | LCie Exchange: 120 Request For Proposal Data Exchange Data Exchange Owner's Representative Architect Contractor 120.01 Receive nformation from A/E to Develop Bid Documents 120.02 Produce RFP Front Matter 120.03 Copy Request for Proposal (RFP) Package 120.04 120.05 Send Request Receive RFP Package for Proposal Ш (RFP) Package Proposal (RFP) LEGEND Eliminated Tasks Automated Tasks Streamlined Tasks Unchanged Tasks

Figure 29. Prepare Invitation to Bid and Receive Proposals (Post-Design).

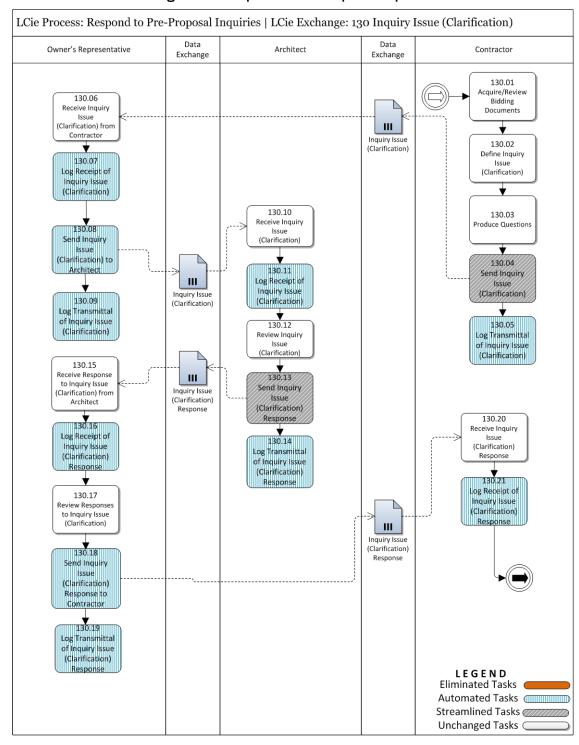


Figure 30. Respond to Pre-Proposal Inquiries.

L Cie Process: Develop Pre-Construction Plan | L Cie Exchange: 140 Pre-Construction Plan Owner's Data Data Architect Contractor Representative Exchange Exchange 140.01 Review Specification Requirements SD-01 Preconstruction Submittal Equipment Lists
Certificates of Insurance Surety Bonds 140.02 List of Proposed Subcontracto Develop Pre-List of Proposed Producers Construction Progress Sched Construction Plan Network Analysis Schedule Submittal Register Schedule of Prices Health and Safety Plan Work Plan Quality Control Plan Environmental Protection Plan 140.03 Submittal Process + LEGEND Automated Tasks (Streamlined Tasks Unchanged Tasks (

Figure 31. Develop Pre-Construction Plan.

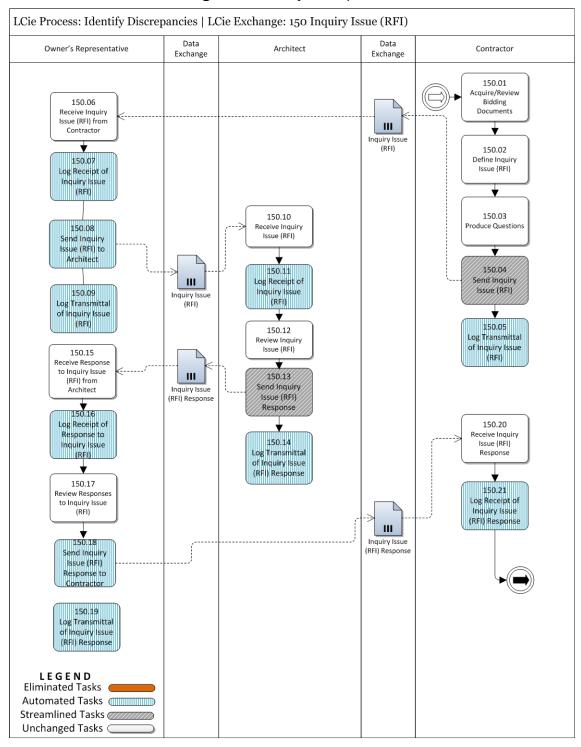


Figure 32. Identify Discrepancies.

LCie Process: Prepare Submittal Information | LCie Exchange: 160 Product Type Selection Owner's Data Data Architect Contractor Representative Exchange Exchange 160.01 **Review Contract** Documents 160.02 Validate Submittal Information 160.03 Submittal Process + LEGEND Eliminated Tasks Automated Tasks Streamlined Tasks @ Unchanged Tasks (

Figure 33. Prepare Submittal Information- Product Type Selection.

LCie Process: Prepare Submittal Information | LCie Exchange: 170 System Layout Data Data Owner's Architect Contractor Representative Exchange Exchange 170.01 Review Contract Drawings 170.02 Layout and Route **Building System** SD-02 Shop Drawings 170.03 Overlay System Layouts (Shop Drawings) 170.04 Identify System Interferences 170.05 Resolve System Interferences 170.06 Update System Layouts (Shop Drawings) All Interferences? 170.07.10 **Submittal Process** + LEGEND **Eliminated Tasks Automated Tasks** Streamlined Tasks **Unchanged Tasks**

Figure 34. Prepare Submittal Information-System Layout.

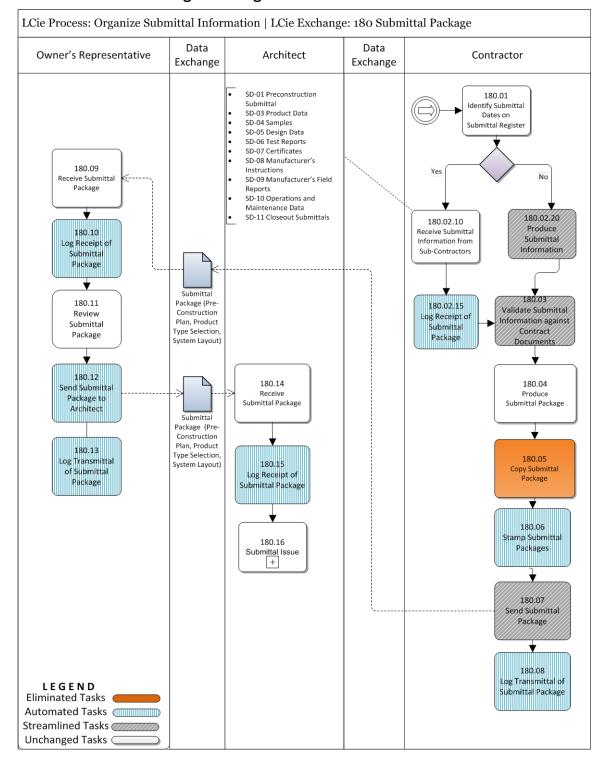


Figure 35. Organize Submittal Information.

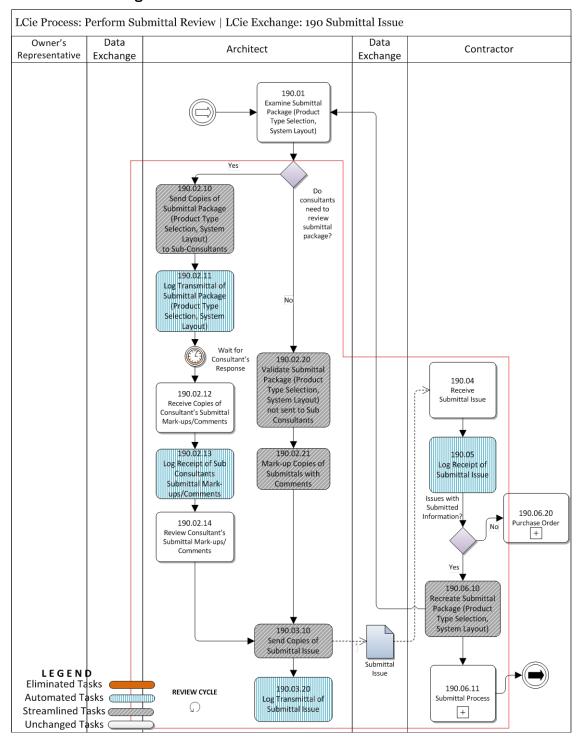


Figure 36. Perform Submittal Review-Submittal Issue.

LCie Process: Provide Resources | LCie Exchange: 200 Purchase Order Data Data Owner's Representative Architect Contractor Exchange Exchange 200.01 Contact Supplier Approved Shop 200.02 Drawings Contract Drawings Contract Specification Schedules Request Quote and Technical 200.03 Receive Quote and Technical Data Does Quote Equipment Specifications? 200.04 Submit Technical Data for Approval 200.05 Receive Approval 200.06 Issue Purchase Order 200.07 Send Purchase Order and Approved Product Type Selection to Supplier LEGEND Eliminated Tasks Automated Tasks (Streamlined Tasks

Figure 37. Provide resources.

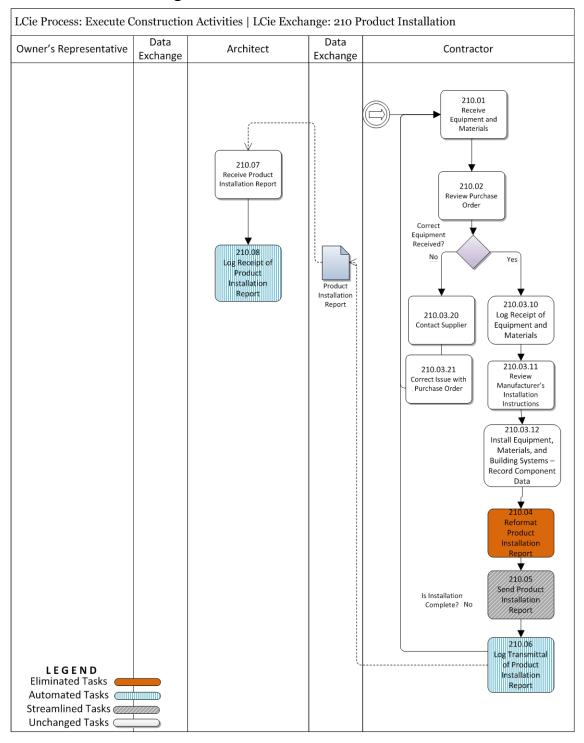


Figure 38. Execute construction activities.

LCie Process: Perform Equipment Testing | LCie Exchange: 220 Start-Up Data Data Owner's Representative Architect Contractor Exchange Exchange 220.01 Send Start-Up Test Procedures and Recording Forms to Owner's Rep. 220.02 Schedule Start-Up Test with Owner's 220.03 Review Manufacturer's Start-Up /Operation Instructions 220.04 Conduct Start-Up / Test of Installed Equipment Start-Up Test Results 220.05 Record Test Results Is Product/Equipment Functioning Properly? 220.06.20 Product Installation + LEGEND Eliminated Tasks Automated Tasks Streamlined Tasks

Figure 39. Perform equipment testing.

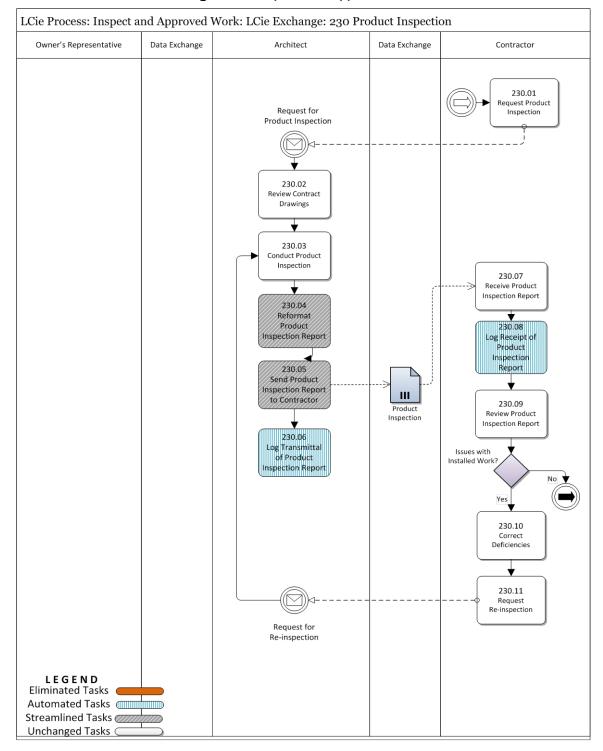


Figure 40. Inspect and approve work.

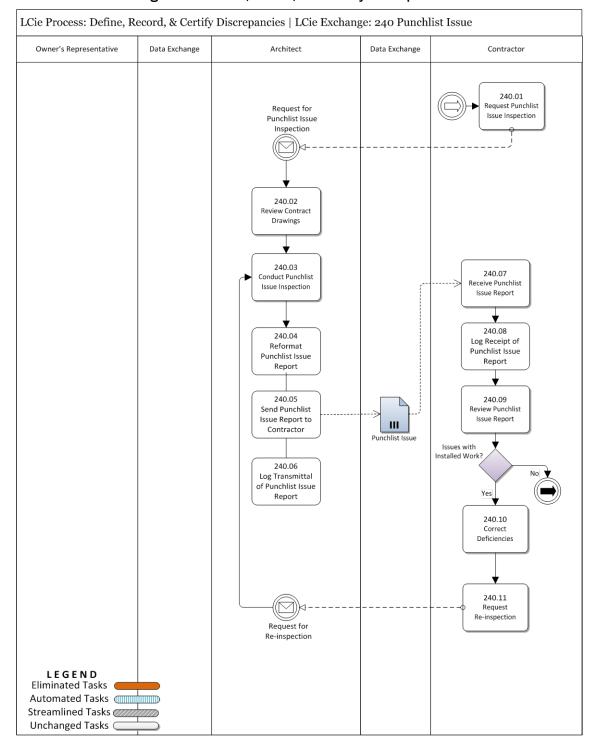


Figure 41. Define, record, and certify discrepancies.

LCie Process: Closeout | LCie Exchange: 250 Turnover Package Data Owner Architect Contractor Exchange Exchange 250.01 Compile Turnover Package Record (As-built Drawings)
Record Specifications
Final Approved Shop Drawings
Operations & Maintenance Manuals
OMSI Files 250.02 Copy Turnover Package Commissioning Report 250.03 Send Copies of Turnover Package 250.04 Log Transmittal of the Turnover Package 250.05 **Receive Copies** of the Turnover Package Turnover Package 250.06 Log Receipt of the Turnover Package 250.07 Review Turnover Package 250.08 File Turnover Package LEGEND Eliminated Tasks Automated Tasks Streamlined Tasks

Figure 42. Closeout.

Appendix D: List of Eliminated, Streamlined, and Automated Tasks

Eliminated tasks —



Study and Define Needs: 010 Facility Criteria

010.02.40 Copy Facility Criteria

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

Develop Design Criteria: 020 Discipline Specifications

020.02.40 Copy Discipline Specification

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

Study Technical Feasibility: 030 Feasibility Study

030.04 Copy Feasibility Study and 030.14 Copy Revised Feasibility Study

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

Communicate Results Decisions: 040 Project Definition

040.03.30 Copy Project Definition

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper

Develop Program – Space Program: 050 Space Program

050.10.10 Send Comments

050.10.20 Log Transmittal of Space Program Comments

050.12 Log Receipt of Space Program Comments

050.13 Re - Search for Space Program Criteria as Necessary

050.14 Send Revised Copies of Space Program

050.15 Log Transmittal of Revised Space Program

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense. And if the Architect/Planner could automate checking of his work product against

the Owner's requirements, then a rework/re-review cycle could be eliminated.

Develop Program – Product Program: 060 Product Program

060.09.10 Send Comments

060.09.20 Log Transmittal of Product Program Comments

060.11 Log Receipt of Product Program Comments

060.12 Re - Search for Product Program Criteria as Necessary

060.13 Send Revised Copies of Product Program

060.14 Log Transmittal of Revised Product Program

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense. And if the Architect/Planner could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

Prepare Invitation to Bid and Receive Proposal (Pre-Design): 070 Request for Proposal (RFP)

070.07 Copy Proposal

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

Explore Concepts - Design Early: 080 Design Early

080.13.10 Make Corrections (Architect and/or Consultants)

Assumptions: If the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

080.13.20 Copy Design Early Documents

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

080.17.20 Send Comments to Design Team

080.17.30 Log Transmittal of Comments

080.18 Receive Review Comments

080.19 Log Receipt of Comments

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense.

Begin Rework Cycle

080.20 R Make Corrections (Architect and /or Consultants)

080.21_R Copy Revised Design Early Documents

080.22_R Send Revised Design Early Documents

080.23_R Log Transmittal of Revised Design Early Documents

080.24_R Receive Design Early Documents

080.25_R Log Receipt of Revised Design Early Documents

080.26_R Validate Revised Design Early Documents - Space and Equipment

080.27_R Send Comments to Design Team

080.28 _R Log Transmittal of Comments

080.29 R Log Receive Review Comments

080.30_R Log Receipt of Comments

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense. And if the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

Develop Design – Design Schematic: 090 Design Schematic, Product Type Template & Product Type Candidate

090.06.10 Make Corrections (Architect and/or Consultants)

Assumptions: If the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

090.06.20 Copy Design Schematic & Product Type Template Documents

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

090.10.20 Send Comments to Design Team

090.10.30 Log Transmittal of Comments

090.11 Receive Review Comments

090.12 Log Receipt of Comments

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense.

Begin Rework Cycle

090.13_R Make Corrections (Architect and/or Consultants)

090.14_R Copy Revised Design Schematic & Product Type Template Documents

090.15_R Send Revised Design Schematic & Product Type Template Documents

090.16_R Log Transmittal of Revised Design Schematic & Product Type Template Documents

090.17_R Receive Revised Design Schematic & Product Type Template Documents

090.18_R Log Receipt of Revised Design Schematic & Product Type Template Documents

090.19_R Validate Revised Design Schematic Space & Product Type Template Documents

090.20_R Send Comments to Design Team

090.21 _R Log Transmittal of Comments

090.22 R Receive Review Comments

090.23 R Log Receipt of Comments

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense. And if the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

Develop Design: 100 Design Coordinated & Product Type Candidate

100.07.05 Make Corrections (Architect and/or Consultants)

Assumptions: If the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

100.07.10 Re- Search and Recreate Product Type Candidates and Detailed Specifications based on QA/QC Results

Assumptions: If the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

100.07.20 Copy Design Coordinated Documents & Product Type Candidate Documents

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper

100.11.20 Send Comments to Design Team

100.11.30 Log Transmittal of Comments

100.12 Receive Review Comments

100.13 Log Receipt of Comments

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense.

Begin Rework Cycle

100.14_R Make Corrections (Architect and/or Consultants)

100.15_R Copy Revised Design Coordinated & Product Type Candidate Documents

100.16_R Send Revised Design Coordinated & Product Type Candidate Documents

100.17_R Log Transmittal of Revised Design Coordinated & Product Type Candidate Documents

100.18_R Receive Design Coordinated & Product Type Candidate Documents

100.19_R Log Receipt of Revised Design Coordinated & Product Type Candidate Documents

100.20_R Validate Revised Design Coordinated Space & Product Type Candidate Documents

100.21_R Send Comments to Design Team

100.22 R Log Transmittal of Comments

100.23 R Receive Review Comments

100.24 R Log Receipt of Comments

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense. And if the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

Finalize Design: 110 Design Final & Product Type Candidate

110.06.10 Make Corrections (Architect and/or Consultants)

Assumptions: If the Architect could automate checking of his work product against the Owner's requirements, then a rework/re-review cycle could be eliminated.

110.06.20 Copy Design Final Documents

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

Prepare Invitation to Bid (Post Design): 120 Request for Proposal

120.03 Copy Request for Proposal (RFP) Package

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

Organize Submittal Information: 180 Submittal Package

180.05 Copy Submittal Package

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper.

Execute Construction Activities: 210 Product Installation

210.04 Reformat Product Installation Report

Assumptions: The use of a structured data format from the onset will eliminate the need to reformat the Product Installation Report.

Closeout: 250 Turnover Package

250.02 Copy Turnover Package

Assumptions: Reproduction savings from reliance on electronic documents and the elimination of paper

Streamlined tasks

Study Technical Feasibility: 030 Feasibility Study

030.05 Send Feasibility Study

030.10.20 Send Comments to Planner

030.15 Send Revised Feasibility Study

Assumptions: An electronic management system will aid in streamlining these processes by reducing time spent preparing transmittals. Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense will also create savings.

Develop Program - Space Program: 050 Space Program

050.05 Send Copies of Space Program

Assumptions: An electronic management system will aid in streamlining these processes by reducing time spent preparing transmittals. Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense will also create savings.

050.09 Validate Space Program

Assumptions: Use of COBie format would permit automated checking and aid in streamlining this process by reducing time spent validating program sent by Architect/Planner.

Develop Program - Product Program: 060 Product Program

060.04 Send Copies of Product Program to Owner for Review

Assumptions: An electronic management system will aid in streamlining this process by reducing time spent preparing transmittals. Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense will also create savings.

060.08 Validate Product Program

Assumptions: Use of COBie format would permit automated checking and aid in streamlining this process by reducing time spent validating program sent by Architect/Planner.

Prepare Invitation to Bid and Receive Proposal (Pre-Design): 070 Request for Proposal (RFP)

070.02 Send Copies of Request for Proposal (RFP) Package

070.08 Send Proposal

Assumptions: An electronic management system will aid in streamlining these processes by reducing time spent preparing transmittals. Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense will also create savings.

Explore Concepts - Design Early: 080 Design Early

080.03 Send Copies of Design Requirements

Assumptions: An electronic management system will aid in streamlining this process by reducing time spent preparing transmittals. Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense will also create savings.

080.12 Validate Checkset before Submission through Manual QA/QC Process – Space and Equipment

Assumptions: COBie would permit the Architect to automate checking of his Concept Design against the Owner's space requirements, saving the Architect time and potentially eliminating a rework/re-review cycle.

080.13.30 Send Design Early Documents and 080.22 Send Revised Design Early Documents

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense

080.16 Validate Design Early Documents – Space and Equipment

Assumptions: Use of COBie format would permit automated checking and aid in streamlining this process by reducing time spent validating program sent by Architect/Planner.

Develop Design – Design Schematic: 090 Design Schematic, Product Type Template & Product Type Candidate

090.02.10 Produce Design Schematic Documents

Assumptions: COBie would permit ease of QTOs for cost estimating, as it addresses spaces and products/equipments and provides space areas and product types and counts.

090.02.20 Produce Outline Specification / Product Type Templates

Assumptions: COBie formatted requirements data could be used directly aiding the Architect to develop product type templates.

090.05 Validate Checkset before Submission through Manual QA/QC Process - Space and Equipment — Space and Equipment

Assumptions: Use of COBie format would permit automated checking of space and product program at this phase prior to submission.

090.06.30 Send Design Schematic and Product Type Template Documents

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense

090.09 Validate Design Schematic Space and Product Type Template Documents and 090.19 Validate Revised Design Schematic Space and Product Type Template Documents

Assumptions: Use of COBie format would permit automated checking of space and product program of Architects submission against Owner requirements by Owners Rep.

Develop Design: 100 Design Coordinated & Product Type Candidate

100.02.10 Produce Design Coordinated Documents

Assumptions: COBie would permit ease of QTOs for cost estimating, as it addresses spaces and products/equipments and provides space areas and product types and counts.

100.02.20 Produce Detailed Specification / Product Type Templates

Assumptions: COBie formatted requirements data could be used directly aiding the Architect to develop product type templates.

100.03 Search for Product Type Candidates

Assumptions: Standard, structured product data available in a COBie format would allow automated product selection based on the product type templates.

100.06 Validate Checkset before Submission through Manual QA/QC Process - Space and Equipment

Assumptions: Use of COBie format would permit automated checking of space and product program at this phase prior to submission.

100.07.30 Send Design Coordinated and Product Type Candidate Documents and 100.16 Send Revised Design Coordinated and Product Type Candidate Documents

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense

100.10 Validate Design Coordinated Space & Product Type Candidate Documents and 100.20 Validate Revised Design Coordinated Space & Product Type Candidate Documents

Assumptions: Use of COBie format would permit automated checking of space and product program of Architects submission against Owner requirements by Owners Rep.

Finalize Design: 110 Design Final & Product Type Candidate

110.02.10 Produce Design Final Documents

Assumptions: COBie would permit ease of QTOs for cost estimating, as it addresses spaces and products/equipments and provides space areas and product types and counts.

110.02.20 Produce Detailed Specification / Product Type Templates

Assumptions: COBie formatted requirements data could be used directly aiding the Architect to develop product type templates.

110.05 Validate Checkset before Submission through Manual QA/QC Process

Assumptions: Use of COBie format would permit automated checking of space and product program at this phase prior to submission.

110.06.30 Send Design Final Documents

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as delivery expense

Prepare Invitation to Bid (Post Design): 120 Request for Proposal

120.04 Send Request for Proposal (RFP) Package

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. A managed electronic collaboration system with a "bidding" module can handle distribution of Requests for Proposal, receiving questions, issuing addenda and receiving and securing the bids submitted by Contractors.

Respond to Pre-Proposal Inquires: 130 Inquiry Issue (Clarification)

130.04 Send Inquiry Issue (Clarification)

130.13 Send Inquiry Issue (Clarification) Response

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. A managed electronic collaboration system with a "bidding" module can handle receipt of bidder questions and issuing addenda.

Identify Discrepancies: 150 Inquiry Issue

150.04 Send Inquiry Issue (RFI)

150.13 Send Inquiry Issue (RFI) Response

Assumptions: Elimination of administrative costs associated with handling paper document transmittals as well as the delivery expense. Managed electronic collaboration systems typically have an RFI module that logs the questions and responses and tracks the time until a response is provided. These systems have proven to reduce RFI turnaround time.

Organize Submittal Information: 180 Submittal Package

180.02.20 Produce Submittal Information

Assumptions: COBie provides information in a concise and computable form allowing the Contractors and Subcontractors to be able to extract product requirements from the specifications.

180.03 Validate Submittal Information against Contract Documents

Assumptions: COBie supports automated checking of the data against the product specifications, saving time and reducing the number of Product Submittals rejected. This reduces rework.

180.07 Send Submittal Package

Assumptions: Elimination of administrative costs associated with handling paper document Submittals as well as the delivery expense. These costs are high, due to the large number of documents and the requirement for multiple copies.

Perform Submittal Review: 190 Submittal Issue

190.02.10 Send Copies of Submittal Package (Product Type Selection, System Layout) to Sub-Consultants

Assumptions: Elimination of administrative costs associated with handling paper document Submittals as well as the delivery expense. These costs are high, due to the large number of documents and the requirement for multiple copies.

190.02.20 Validate Submittal Package not sent to Sub-Consultants

Assumptions: COBie supports automated checking, saving time as the Submittal Reviewers must check the Product Submittal data against the specifications.

190.02.21 Mark-up Copies of Submittals with Comments

Assumptions: The reliance on electronic documents and data eliminates the need to mark up copies of submittals and reduce costs which are usu-

ally high, due to large number of documents and the requirement of multiple copies.

190.03.10 Send Copies of Submittal Issues

Assumptions: Elimination of administrative costs associated with handling paper document Submittals as well as the delivery expense.

190.06.10 Recreate Submittal Package (Product Type Selection, System Layout)

Assumptions: COBie supports automated validation product characteristics against the specification, lowering the number of Product Submittals rejected.

Execute Construction Activities: 210 Product Installation

210.05 Send Product Installation Report

Assumptions: Elimination of administrative costs associated with handling paper documents as well as the delivery expense.

Inspect and Approved Work: 230 Product Inspection

230.04 Reformat Product Inspection

Assumptions: COBie would provide a definitive list of items required per room or floor that could be "checked off" and automatically totaled. This would allow the Architect to reduce office time.

230.05 Send Product Inspection Report to Contractor

Assumptions: Elimination of administrative costs associated with handling paper documents as well as the delivery expense. Managed electronic collaboration systems can notify the Contractor if the Pay Request has been accepted or rejected and deliver the Observation Field Report with tracking.

Closeout: 250 Turnover Package

250.01 Compile Turnover Package

Assumptions: A managed electronic collaboration system stores and indexes all documents submitted as they are uploaded. This greatly reduces the time required to find the necessary documents and assemble the Turnover Package, saving the Contractor time, improving the completeness and quality of the Turnover Package, and making the Turnover Package available to the Owner at an earlier date.

250.03 Send Copies of Turnover Package

Assumptions: Reproduction savings from turnover of electronic documents and data and the elimination of paper and elimination of adminis-

trative costs associated with handling paper documents as well as the delivery expense.

250.07 Review Turnover Package

250.08 File Turnover Package

Assumptions: A managed electronic collaboration system stores and indexes all documents submitted as they are uploaded.

Automated tasks (

Study Technical Feasibility: 030 Feasibility Study

030.06 Log Transmittal of Feasibility Study

030.08 Log Receipt of Feasibility Study

030.10.21 Log Transmittal of Feasibility Study Comments

030.12 Log Receipt of Review Comments

030.16 Log Transmittal of Revised Feasibility Study

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Develop Program - Space Program: 050 Space Program

050.03 Search for Space Program Criteria as Necessary

Assumptions: COBie-formatted data would permit data to be transferred directly from the Owner to the Architect or Planner's system. This ensures that the Architect won't need to search for the data received from the Owner.

050.04 Reformat Space Program Criteria into Room Data Sheets

Assumptions: COBie format would either eliminate the need to produce room data sheets or support automation of their production. This ensures that the Architect won't need to reformat the data received from the Owner.

050.06 Log Transmittal of Space Program

050.08 Log Receipt of Space Program

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Develop Program - Product Program: 060 Product Program

060.03 Search for Product Program Criteria as Necessary

Assumptions: COBie-formatted product standards would permit direct transfer from the Owner to the Architect or Planner's system. This ensures that the Architect won't need to search for the data received from the Owner.

060.05 Log Transmittal of Product Program

060.07 Log Receipt of Product Program

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Prepare Invitation to Bid and Receive Proposal (Pre-Design): 070 Request for Proposal (RFP)

070.04 Log Receipt of Request for Proposal (RFP) Package

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Explore Concepts - Design Early: 080 Design Early

080.08 Reformat Design Requirements

Assumptions: COBie-formatted requirements data permits direct transfer from the Owner to the design consultants' systems. This ensures that the Architect won't need to reformat the data received from the Owner.

080.04 Log Transmittal of Design Requirements

080.06 Log Receipt of Design Requirements

080.13.40 Log Transmittal of Design Early Documents

080.15 Log Receipt of Design Early Documents

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Develop Design – Design Schematic: 090 Design Schematic, Product Type Template & Product Type Candidate

090.06.40 Log Transmittal of Design Schematic Documents & Product Type Template Documents

090.08 Log Receipt of Design Schematic & Product Type Template Documents

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Develop Design: 100 Design Coordinated & Product Type Candidate

100.07.40 Log Transmittal of Design Coordinated and Product Type Candidate Documents

100.09 Log Receipt of Design Coordinated and Product Type Candidate Documents

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Finalize Design: 110 Design Final & Product Type Candidate

110.06.40 Log Transmittal of Design Final Documents

110.08 Log Receipt of Design Final Documents for Bidding Process

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Prepare Invitation to Bid (Post Design): 120 Request for Proposal

120.01 Receive Information from A/E to Develop Bid Documents

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Respond to Pre-Proposal Inquires: 130 Inquiry Issue (Clarification)

130.05 and 130.09 Log Transmittal of Inquiry Issue (Clarification)

130.07 and 130.11 Log Receipt of Inquiry Issue (Clarification)

130.08 Send Inquiry Issue (Clarification) to Architect

130.14 and 130.19Log Transmittal of Inquiry Issue (Clarification) Response

130.16 Log Receipt of Inquiry Issue (Clarification) Response

130.18 Send Inquiry Issue (Clarification) Response to Contractor

130.21 Log Receipt of Inquiry Issue (Clarification) Response

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents.

Identify Discrepancies: 150 Inquiry Issue

150.05 and 150.09 Log Transmittal of Inquiry Issue (RFI)

150.07 and 150.11 Log Receipt of Inquiry Issue (RFI)

150.08 Send Inquiry Issue (RFI) to Architect

150.14 and 150.19 Log Transmittal of Inquiry Issue (RFI) Response

150.16 Log Receipt of Response to Inquiry Issue (RFI)

150.18 Send Inquiry Issue (RFI) Response to Contractor

150.21 Log Receipt of Inquiry Issue (RFI) Response

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Organize Submittal Information: 180 Submittal Package

180.02.15 Log Receipt of Submittal Package from Sub-Contractors and Vendors

180.06 Stamp Submittal Package

180.08 and 180.13 Log Transmittal of Submittal Package

180.10 and 180.15 Log Receipt of Submittal Package

180.12 Send Submittal Package to Architect

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Perform Submittal Review: 190 Submittal Issue

190.02.11 Log Transmittal of Submittal Package (Product Type Selection, System Layout)

190.02.13 Log Receipt of Sub Consultants Submittals Mark-ups/Comments

190.03.20 Log Transmittal of Submittal Issue

190.05 Log Receipt of Submittal Issues

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Execute Construction Activities: 210 Product Installation

210.06 Log Transmittal of Product Installation Report

210.08 Log Receipt of Product Installation Report

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Inspect and Approved Work: 230 Product Inspection

230.06 Log Transmittal of Product Inspection Report

230.08 Log Receipt of Product Inspection Report

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Closeout: 250 Turnover Package

250.04 Log Transmittal of Turnover Package

250.06 Log Receipt of Turnover Package

Assumptions: Managed electronic collaboration systems will notify intended recipients when e-documents are released and automatically log both the issuing and viewing of those documents

Appendix E: Current and Expected Variable Definitions by LCie Process

Appendix C describes 210 cost variables in the life cycle processes. It also provides values for these variables, derived from published cost indices as well as project records provided by owners. Where the cost data were incomplete, the authors drew upon their professional experience to provide estimates.

The estimates provided for the Current LCie Processes assume paperbased communication and no use of data exchanges in standard structured form. The estimates provided for the improved LCie processes assume the use of an electronic collaboration system and a structured data format.

General Reproduction Variables

Avg. per Page Cost (\$/page): Actual cost information from Architect's Invoices for pages up to 11"x17" in size from project analyzed.

- Current Life Cycle Process: Estimate \$0.15 / page
- Expected Life Cycle Process: Estimate -/ page based on the reduction factor times the Current Life Cycle Process estimate.

Avg. per Sheet Copy Cost (\$/page): Actual cost information from Architect's Invoices for pages from 11"x17" up to 30"x42" in size from project analyzed.

- Current Life Cycle Process: Estimate \$3.00 / page
- Expected Life Cycle Process: Estimate -/ page based on the reduction factor times the Current Life Cycle Process estimate.

Organizational Variables

Owner's Administrative Rate: Rate for activities that cover handling of documents. Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for executive secretaries and administrative assistants. No overhead or profit was applied to this rate since this is an internal cost to the Owner.

- Current Life Cycle Process: Estimate \$23.71 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Owner's Rep. Rate: Rate for activities that include validating documents.

Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for Architectural & Engineering Managers. No overhead or profit was applied to this rate since this is an internal cost to the Owner.

- Current Life Cycle Process: Estimate \$62.20 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Owner's Rep. Administrative Rate: Rate for activities that cover handling of documents. Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for secretaries and administrative assistants. No overhead or profit was applied to this rate since this is an internal cost to the Owner.

- Current Life Cycle Process: Estimate \$16.88 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Planner Rate: Rate for professional assisting owner in pre-design activities. Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for secretaries and administrative assistants. No overhead or profit was applied to this rate since this is an internal cost to the Owner.

- Current Life Cycle Process: Estimate \$37.84 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Planner Administrative Rate: Rate for activities that cover Handling of documents. Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for secretaries and administrative assistants. No overhead or profit was applied to this rate since this is an internal cost to the Owner.

- Current Life Cycle Process: Estimate \$16.88 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Licensed Professional Architect Rate: Rate for licensed Architect. Rates were indicated on Architect's monthly billing invoices. This is a blended rate for all architects based on 2008 actual fee billed on the project analyzed.

- Current Life Cycle Process: Estimate \$109.99 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Specifier Rate: Rate for Specifier. Rate includes Professional Services, Overhead and Profit.

- Current Life Cycle Process: Estimate \$109.99 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Architectural Drafter Rate: Rate drafter. Rates were indicated on Architect's monthly billing invoices. This rate is based on 2008 actual fee billed on the project analyzed.

- Current Life Cycle Process: Estimate \$70.70 / hour
- **Expected Life Cycle Process:** Same as the Current Life Cycle Process estimate.

Architect Administrative Rate: Rate for activities that cover Handling of documents. Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for secretaries and administrative assistants. The fee of \$16.88 was marked up to match the percentages indicated on the Architect's invoice. (147.5% overhead and 10% profit.)

- Current Life Cycle Process: Estimate \$45.96 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Construction Project Manager Rate: Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for Construction Managers. The fee of \$45.75 was marked up to match average industry percentages for overhead and profit. (150% overhead and 10% profit.)

- Current Life Cycle Process: Estimate \$125.81 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Assistant Construction Project Manager Rate: Amount based on Payscale.com's (2012) hourly rate for Assistant Project Managers. The fee of \$27.01 was marked up to match average industry percentages for overhead and profit. (150% overhead and 10% profit.)

- Current Life Cycle Process: Estimate \$70.53 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Contractor Administrative Rate: Amount based on U.S. Bureau of Labor Statistics' NAICS 2011 average hourly rate for secretaries and administrative assistants. The fee of \$27.01 was marked up to match average industry percentages for overhead and profit. (150% overhead and 10% profit.)

- Current Life Cycle Process: Estimate \$44.19 / hour
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Printing Variables

Small Format Printer: Printer capable of printing document sizes up to 11"x17". Print Speed:

- Current Life Cycle Process: Estimate 25 ppm
- Expected Life Cycle Process: Estimate Oppm based on the reduction factor times the Current Life Cycle Process estimate.

Large Format Printer: Printer capable of printing document sizes from 11"x17" - 30"x42". Print Speed:

- Current Life Cycle Process: Estimate- 30"x42": 6 ppm, 24"x36": 9 ppm
- Expected Life Cycle Process: Estimate Oppm based on the reduction factor times the Current Life Cycle Process estimate.

Study and Define Needs: 010 Facility Criteria

010.02.40 Copy Facility Criteria

Avg. Number of Pages in Facility Criteria: The average number of pages in Owner's initial analysis of project need and scope.

- Current Life Cycle Process: Estimate 20 pages based on information in Owner's facility planning criteria document from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sets Required: The average number printed sets required.

- Current Life Cycle Process: Estimate 2 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time required to print each set.

- Current Life Cycle Process: Estimate 1.6 minutes assuming use of small format printer indentified above.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Develop Design Criteria: 020 Discipline Specifications

020.02.40 Copy Discipline Specification

Avg. Number of Pages in Discipline Specification: The average number of pages in Equipment performance requirements during planning.

- Current Life Cycle Process: Estimate 549 pages based on information in Owner's design guidelines and design criteria documents from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sets Required: The average number printed sets required.

- Current Life Cycle Process: Estimate 2 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time required to print each set.

- Current Life Cycle Process: Estimate 22 minutes assuming use of small format printer indentified above.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Study Technical Feasibility: 030 Feasibility Study

030.04 Copy Feasibility Study and 030.14 Copy Revised Feasibility Study

Avg. Number of Options: The average number of pre-design options created by the planner for early analysis of concepts.

- Current Life Cycle Process: Estimate 3 options based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sheets per Option: The average number of drawing sheets included in each option.

- Current Life Cycle Process: Estimate 8 sheets per option based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Pre-Design Narrative per Op-

tion: The average number of pages included in the pre-design narrative per option.

- Current Life Cycle Process: Estimate 10 total pages based on number of narrative topics (10) identified in UFC documentation. This assumes one page per topic at this stage in the process.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pre-Design Submittal Sets Required: The average number of pre-design drawing sets required for each submittal.

- **Current Life Cycle Process:** Estimate 2 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time required to print each set.

- Current Life Cycle Process: Estimate 3 minutes assuming use of both small format and large format printers indentified above.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

030.05 Send Feasibility Study and 030.15 Send Revised Feasibility Study

Avg. Number of Transmittals: The average number of times options are sent by the Planner to the Owner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of feasibility study based on past experience with pre-design workflows.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Planner and Owner.

- Current Life Cycle Process: Estimate \$20.10 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- **Expected Life Cycle Process:** Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

030.06 Log Transmittal Feasibility Study and 030.16 Log Transmittal of Revised Feasibility Study

Avg. Number of Transmittals: The average number of times options are logged out by the Planner.

- Current Life Cycle Process: Estimate 2 based on number of times feasibility study is sent.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 30 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

030.08 Log Receipt Feasibility Study

Avg. Number of Transmittals: The average number of times options / comments are received by the Owner from the Planner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times feasibility study is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

030.10.20 Send Comments to Planner

Avg. Number of Transmittals: The average number of times options / comments are sent to the Planner from the Owner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times feasibility study is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Planner and Owner.

- Current Life Cycle Process: Estimate \$20.10 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent in compiling documents for transmittal.

Current Life Cycle Process: Estimate 30 minutes for this task.

Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

030.10.21 Log Transmittal of Feasibility Study Comments

Avg. Number of Transmittals: The average number of times options / comments are sent/received by the Owner to/from the Planner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times feasibility study is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

030.12 Log Receipt of Review Comments

Avg. Number of Transmittals: The average number of times options / comments are sent/received by the Owner to/from the Planner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times feasibility study is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Communicate Results Decisions: 040 Project Definition

040.03.30 Copy Project Definition

Avg. Number of Pages in Project Definition: The average number of pages in Project Definition document. The Project Definition defines the project scope, budget requirements, site details, economic analysis and facility planning data.

 Current Life Cycle Process: Estimate 20 pages based on information in Owner's facility planning criteria document from project analyzed. Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sets Required: The average number printed sets required.

- Current Life Cycle Process: Estimate 2 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 sets based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time required to print each set.

- Current Life Cycle Process: Estimate 1.6 minutes assuming use of small format printer indentified above.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Develop Program – Space Program: 050 Space Program

050.03 Search for Space Program Criteria as Necessary

Number of Space Types per Building: The average number of space types found in building.

- Current Life Cycle Process: Estimate 27 space types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Searching for Space Program Criteria: The average time spent by Planner searching for Spatial Requirements.

- Current Life Cycle Process: Estimate 15 minutes per space types indentified in project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

050.04 Reformat Requirements into Room Data Sheets for Project

Number of Space Types per Building: The average number of space types found in building.

- Current Life Cycle Process: Estimate 27 space types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Reformatting Space Program Criteria into Room Da-

ta Sheets: The average time spent by Planner in evaluating information in Project Definition and identifying and creating a detailed spatial program in a usable format.

- Current Life Cycle Process: Estimate 9 minutes per room data sheet based on space types in project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

050.05 Send Copies of Space Program

Avg. Number of Pages in Space Program: The average number of pages in Owner's space program document.

- Current Life Cycle Process: Estimate 10 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Transmittals: The average number of times options are sent by the Planner to the Owner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of space program.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Planner and Owner.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Pre-Design Submittal Sets Required: The average number of pre-design drawing sets required for each submittal.

- Current Life Cycle Process: Estimate 2 set based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 sets based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Planner in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

050.06 Log Transmittal of Space Program

Avg. Number of Transmittals: The average number of times documents are logged out by the Planner.

- Current Life Cycle Process: Estimate 2 based on number of times space program is sent.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

050.08 Log Receipt Space Program

Avg. Number of Transmittals: The average number of times space program is received by the Owner from the Planner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times space program is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

050.09 Validate Space Program

Avg. Time for Owners Rep to Validate Space Program: The average time spent by Owner's Rep. in validating Space Program provided by Planner.

- Current Life Cycle Process: Estimate 1 hour for this task based on number of spaces in project analyzed.
- Expected Life Cycle Process: Estimate 6 minutes based on the reduction factor times the Current Life Cycle Process estimate.

050.10.10 Send Comments

Avg. Number of Transmittals: The average number of times comments are

sent by the Owner's Rep. to the Planner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of comments.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Planner and Owner.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep. in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted.

- *Current Life Cycle Process:* Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

050.10.20 Log Transmittal of Space Program Comments

Avg. Number of Transmittals: The average number of times documents / comments are logged out by the Owner's Rep.

- *Current Life Cycle Process:* Estimate 2 based on number of times space program comments are sent.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted.

- Current Life Cycle Process: Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

050.12 Log Receipt Space Program Comments

Avg. Number of Transmittals: The average number of times documents / comments are received by the Planner from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times space program comments is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted.

- **Current Life Cycle Process:** Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

050.13 Re - Search for Space Program Criteria as Necessary

Avg. Percentage of Errors in Space Program: The average percentage of errors found by Owners Rep in Space Program.

- Current Life Cycle Process: Estimate 30% based on number of comments received during early design phase for project analyzed.
- Expected Life Cycle Process: Estimate 0% based on the reduction factor times the Current Life Cycle Process estimate.

Number of Space Types per Building: The average number of space types found in building.

- Current Life Cycle Process: Estimate 27 space types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Searching for Space Program Criteria: The average time spent by Planner recreating Space Program.

- Current Life Cycle Process: Estimate 5 minutes per space types indentified in project analyzed.
- **Expected Life Cycle Process:** Estimate 0 minutes per space based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted.

- *Current Life Cycle Process:* Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

050.14 Send Revised Copies of Space Program

Reference variables in section 050.05 Send Copies of Space Program, in addition uses variable Avg. Number of Re-Submit Cycles from 050.13 Re - Search for Space Program Criteria as Necessary

050.15 Log Transmittal of Revised Space Program

Reference variables in section 050.06 Log Transmittal of Space Program, in addition uses variable Avg. Number of Re-Submit Cycles from 050.13 Recreate Space Program.

Develop Program – Product Program: 060 Product Program

060.03 Search for Product Program Criteria as Necessary

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Searching for Product Program Criteria: The average time spent by Planner searching for product program criteria.

- Current Life Cycle Process: Estimate 10 minutes per product type based on equipment types in project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes per product type based on the reduction factor times the Current Life Cycle Process estimate.

060.04 Send Copies of Product Program to Owner for Review

Avg. Number of Pages in Product Program: The average number of pages in Product Program that documents Owners equipment specifications and performance.

- Current Life Cycle Process: Estimate 28 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Transmittals: The average number of times product program is sent by the Planner to the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of product program.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Planner and Owner.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Pre-Design Submittal Sets Required: The average number of pre-design drawing sets required for each submittal.

- Current Life Cycle Process: Estimate 2 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 sets based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Planner in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

060.05 Log Transmittal of Product Program

Avg. Number of Transmittals: The average number of times documents are logged out by the Planner.

- Current Life Cycle Process: Estimate 2 based on number of times product program is sent.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

060.07 Log Receipt of Product Program

Avg. Number of Transmittals: The average number of times documents are received by the Owner's Rep. from the Planner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times product program is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

060.08 Validate Product Program

Avg. Time for Owners Rep to Validate Product Program: The average time spent by Owner's Rep. in validating product program provided by Planner.

- Current Life Cycle Process: Estimate 4 hours for this task based on number of products types in project analyzed.
- Expected Life Cycle Process: Estimate 24 minutes based on the reduction factor times the Current Life Cycle Process estimate.

060.09.10 Send Comments

Avg. Number of Transmittals: The average number of times documents / comments are sent by the Owner's Rep. to the Planner times the number of recipients for each exchange.

Current Life Cycle Process: Estimate 2 transmittals of comments.

Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Planner and Owner.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep. in compiling documents / comments for transmittal.

- Current Life Cycle Process: Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted

- Current Life Cycle Process: Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

060.09.20 Log Transmittal of Product program Comments

Avg. Number of Transmittals: The average number of times documents / comments are logged out by the Owner's Rep.

- Current Life Cycle Process: Estimate 2 based on number of times product program comments are sent.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted

- *Current Life Cycle Process:* Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

060.11 Log Receipt of Product Program Comments

Avg. Number of Transmittals: The average number of times documents / comments are received by the Planner from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times product program comments is received.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted.

- *Current Life Cycle Process:* Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

060.12 Re - Search for Product Program Criteria as Necessary

Avg. Percentage of Errors in Product Program: The average number of errors found in Planner's product program vs. the Owner's space requirements.

- Current Life Cycle Process: Estimate 30% based on number of comments received during early design phase for project analyzed.
- **Expected Life Cycle Process:** Estimate 0% based on the reduction factor times the Current Life Cycle Process estimate.

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Searching for Product Program Criteria: The average time spent by Planner recreating Product program.

- Current Life Cycle Process: Estimate 5 minutes per product types indentified in project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The average number of times submitted documents are re-submitted.

- *Current Life Cycle Process:* Estimate 1 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

060.13 Send Revised Copies of Product Program

Reference variables in section 060.04 Send Copies of Product Program to Owner for Review, in addition uses variable Avg. Number of Re-Submit Cycles from 060.12 Recreate Product Program

060.14 Log Transmittal of Revised Product Program

Reference variables in section 060.05 Log Transmittal of Product Program, in addition uses variable Avg. Number of Re-Submit
Cycles from 060.12 Re - Search for Product Program Criteria as Necessary

Prepare Invitation to Bid and Receive Proposal (Pre-Design): 070 Request for Proposal (RFP)

070.02 Send Copies of Request for Proposal (RFP) Package

Avg. Number of Pages in Space Program: The average number of pages in Owner's space program document.

- *Current Life Cycle Process:* Estimate 10 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages in Product Program: The average number of pages in Product Program that documents Owners equipment specifications and performance.

- Current Life Cycle Process: Estimate 28 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages in Project Definition: The average number of pages in Project Definition document. The Project Definition defines the project scope, budget requirements, site details, economic analysis and facility planning data.

- Current Life Cycle Process: Estimate 20 pages based on information in Owner's facility planning criteria document from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages in Front Matter: The average number of pages that precede the technical content of the RFP for Design and Construction Services.

- Current Life Cycle Process: Estimate 25 pages.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Transmittals: The average number of times RFP is sent by the Owner to Bidders times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 5 transmittals of RFP. Assume an average of five bidders.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Owner's Rep to Bidders.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of RFP Submittal Sets Required: The average number printed sets required.

- Current Life Cycle Process: Estimate 6 total sets based on copies required for bidders (5) and (1) copy for the Owner.
- Expected Life Cycle Process: Estimate 0 sets based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep. in compiling documents for transmittal.

- **Current Life Cycle Process:** Estimate 12 minutes for this task.
- Expected Life Cycle Process: Estimate 5 minutes based on the reduction factor times the Current Life Cycle Process estimate.

070.04 Log Receipt of Request for Proposal (RFP) Package

Time to Log: The average time spent by Architect logging RFP package in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

070.07 Copy Proposal

Avg. Number of Letter-Sized Pages in Proposal: The average number of letter-sized pages in proposal.

- Current Life Cycle Process: Estimate 31 total pages. Based on government standard proposal form SF-330 (6 pages) and the assumption that each discipline (assume 5) participating in the proposal will contribute 5 additional pages each.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Drawing Sheets in Proposal: The average number drawing sheets included in proposal.

- Current Life Cycle Process: Estimate 2 drawings included in proposal containing examples of work related to RFP.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pre-Design Submittal Sets Required: The average number of pre-design drawing sets required for each submittal.

- Current Life Cycle Process: Estimate 2 total sets; (1) for the Owner and
 (1) for the Architect.
- Expected Life Cycle Process: Estimate 0 sets based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time spent printing documents.

- Current Life Cycle Process: Estimate 2 minutes per set based on printer specifications provided in the Printing Variables section of this appendix.
- Expected Life Cycle Process: Estimate 0 minutes per set based on the reduction factor times the Current Life Cycle Process estimate.

070.08 Send Proposal

Avg. Number of Transmittals: The average number of times proposal is sent by the Architect to the Owner.

- Current Life Cycle Process: Estimate 2 transmittals of proposal.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Owner's Rep to Bidders.

 Current Life Cycle Process: Estimate \$18.80 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents. Expected Life Cycle Process: Estimate - based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Explore Concepts - Design Early: 080 Design Early

080.03 Send Copies of Design Requirements

Avg. Number of Pages in Space Program: The average number of pages in Owner's space program document.

- Current Life Cycle Process: Estimate 10 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages in Product Program: The average number of pages in Product Program that documents Owners equipment specifications and performance.

- *Current Life Cycle Process:* Estimate 28 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages in Project Definition: The average number of pages in Project Definition document. The Project Definition defines the project scope, budget requirements, site details, economic analysis and facility planning data.

- Current Life Cycle Process: Estimate 20 pages based on information in Owner's facility planning criteria document from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Owner's Rep to Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep. in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.04 Log Transmittal of Design Requirements

Time to Log: The average time spent by Owner's Rep. logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare information, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.06 Log Receipt of Design Requirements

Time to Log: The time spent by Architect logging RFP package in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.08 Reformat Design Requirements

Number of Space Types per Building: The average number of space types found in building.

- Current Life Cycle Process: Estimate 27 space types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Reformatting Space Program: The average spent by Architect in documenting spatial requirements in a usable format.

- **Current Life Cycle Process:** Estimate 10 minutes for each space type in the project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes for each space type based on the reduction factor times the Current Life Cycle Process estimate.

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Reformatting Product Program: The average time spent by Architect documenting product type requirements in a usable format.

- **Current Life Cycle Process:** Estimate 15 minutes for each equipment type in project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes for each equipment type based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Time Spent by Licensed Professional Architect: The percentage of time spent by Licensed Architect reformatting Space Program and Equipment Types.

- Current Life Cycle Process: Estimate 90% based on time spent by Architect on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Architectural Drafter: The percentage of time spent by Drafter reformatting Space Program and Equipment Types.

- Current Life Cycle Process: Estimate 10% based on time spent by Drafter on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

080.12 Validate Checkset Before Submission Through Manual QA/QC Process – Space and Equipment

Avg. Time Spent Evaluating Design Early Drawings Against Design Requirements – Space and Equipment: The average time spent by Architect in validating Design Early drawings against space and equipment requirements before submission to Owners Rep.

- *Current Life Cycle Process:* Estimate 16.3 hours based on project analyzed. The Architect spent 6,522 hours total on this phase of the design. Assume 5% (326 hours) of the time allotted for internal checking of the entire document. 16.3 hours assumes that 5% of the allotted checking time is set aside for checking space and equipment requirements.
- **Expected Life Cycle Process:** Estimate 1.7 hours based on the reduction factor times the Current Life Cycle Process estimate.

080.13.10 Make Corrections (Architect and/or Consultants)

Avg. Time Spent Making Corrections due to Non-Conformance with Space or Product Program: The average time spent by Architect making corrections to space and equipment documentation based on internal

validation.

- *Current Life Cycle Process:* Estimate 1.1 hours based on number comments received related to space and equipment (13) on project analyzed. Assume 5 minutes per comment.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.13.20 Copy Design Early Documents

Avg. Number of Sheets in Design Early Drawings: The average number Design Early drawing sheets.

- Current Life Cycle Process: Estimate 132 based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Early Narrative: The average number of letter-sized pages in the Design Early narrative.

- *Current Life Cycle Process:* Estimate 6 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Design Submittal Sets Required: The number of design phase drawing sets required.

- Current Life Cycle Process: Estimate 3 total sets based on project analyzed.
- Expected Life Cycle Process: Estimate 0 sets based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time spent printing documents.

- Current Life Cycle Process: Estimate 22 minutes per set based on printer specifications provided in the Printing Variables section of this appendix.
- Expected Life Cycle Process: Estimate 0 minutes per set based on the reduction factor times the Current Life Cycle Process estimate.

080.13.30 Send Design Early Documents

Avg. Number of Transmittals: The average number of times documents are sent by the Architect to the Owner.

- Current Life Cycle Process: Estimate 2 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Architect Rep to Owner's Rep.

- Current Life Cycle Process: Estimate \$47.56 based on actual shipping cost in project analyzed.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.13.40 Log Transmittal of Design Early Documents

Avg. Number of Transmittals: The average number of times documents are logged out by the Architect.

- Current Life Cycle Process: Estimate 2 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.15 Log Receipt of Design Early Documents

Avg. Number of Transmittals: The average number of times documents are received by the Owner's Rep. from the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based number of times Design Early Documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.16 Validate Design Early Documents - Space and Equipment

Avg. Time to Review Design Early Drawings for conformance to Space and Product Program: The average time spent by Owner's Rep. in validating space and equipment documentation in Design Early Documents provided by Architect.

- Current Life Cycle Process: Estimate 11 hours based on number drawings in Design Early Documents in project analyzed. Assume 15 minutes per drawing or 33 hours total time. Assume 1/3 of this time allotted for checking space and equipment requirements.
- Expected Life Cycle Process: Estimate 1.1 hours based on the reduction factor times the Current Life Cycle Process estimate.

080.17.20 Send Comments to Design Team

Avg. Number of Transmittals: The average number of times comments are sent by the Owner's Rep. to the Architect times the number of recipients for each exchange.

- **Current Life Cycle Process:** Estimate 2 transmittals of comments based on number of times documents were received in the project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Owner's Rep. to the Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep. in compiling documents / comments for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- **Expected Life Cycle Process:** Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.17.30 Log Transmittal of Comments

Avg. Number of Transmittals: The average number of times documents / comments are sent by the Owner's Rep. to the Architect times the number of recipients for each exchange.

Current Life Cycle Process: Estimate 2 based on number of times comments were sent on project analyzed.

Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.19 Log Receipt of Comments

Avg. Number of Transmittals: The average number of times documents / comments are received by the Architect from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times comments were received on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

080.20 Make Corrections (Architect and/or Consultants)

Avg. Time Spent Making Corrections Due to Non-conformance with Space or Product Program: The average time spent by Architect making corrections to space and equipment documentation based on feedback from Owners Rep.

- Current Life Cycle Process: Estimate 1.1 hours based on number comments received related to space and equipment (13) on project analyzed. Assume 5 minutes per comment.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The Average number of times documentation is examined.

- Current Life Cycle Process: Estimate 2 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

080.21 Copy Revised Design Early Documents

Uses variables in section 080.13.20 Copy Design Early Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20 Make Corrections (Architect and/or Consultants).

080.22 Send Revised Design Early Documents

Reference variables in section 080.13.30 Send Design Early Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20 Make Corrections (Architect and/or Consultants).

080.23 Log Transmittal of Revised Design Early Documents

Reference variables in section 080.13.40 Log Transmittal of Design Early Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20 Make Corrections (Architect and/or Consultants).

080.25 Log Receipt of Revised Design Early Documents

Reference variables in section 080.15 Log Receipt of Design Early Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20 Make Corrections (Architect and/or Consultants).

080.26 Validate Revised Design Early Documents

Reference variables in section 080.16 Validate Design Early Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20 Make Corrections (Architect and/or Consultants).

080.27 Send Comments to Design Team

Reference variables in section 080.17.20 Send Comments to Design Team, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20 Make Corrections (Architect and/or Consultants).

080.28 Log Transmittal of Comments

Reference variables in section 080.17.30 Log Transmittal of Comments, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20

Make Corrections (Architect and/or Consultants).

080.30 Log Receipt of Comments

Reference variables in section 080.19 Log Transmittal of Comments, in addition uses variable Avg. Number of Re-Submit Cycles from 080.20 Make Corrections (Architect and/or Consultants).

Develop Design - Design Schematic: 090 Design Schematic

090.02.10 Produce Design Schematic Documents

Avg. Number of Plan Drawings in Design Schematic Drawings: The average number of plans in submittal.

- Current Life Cycle Process: Estimate 26 based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. QTO Time for Equipment Components: The average time spent performing quantity take-off of equipment shown on plan drawings.

- Current Life Cycle Process: Estimate 5 minutes based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 30 seconds based on the reduction factor times the Current Life Cycle Process estimate.

Avg. QTO Time for Spaces in Building: The average time spent performing quantity take-off of spaces shown on plan drawings.

- Current Life Cycle Process: Estimate 10 minutes based on information obtained from project analyzed.
- **Expected Life Cycle Process:** Estimate 1 minute based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Time Spent by Licensed Professional Architect: Percentage of time spent by Licensed Architect to perform quantity take-off of all equipment and to calculate space areas shown on plan drawings.

- Current Life Cycle Process: Estimate 80% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Architect Drafter: Percentage of time spent by Architectural Drafter to perform quantity take-off of all equipment and to calculate space areas shown on plan drawings.

- Current Life Cycle Process: Estimate 20% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

090.02.20 Produce Outline Specification / Product Type Templates

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Developing Equipment Type Templates: The average time spent by Architect in developing specifications for equipment types required for the project.

- Current Life Cycle Process: Estimate 15 minutes per product type. Assume 85 product types based on project analyzed.
- Expected Life Cycle Process: Estimate 4.5 minutes per product type based on the reduction factor times the Current Life Cycle Process estimate.

090.05 Validate Checkset before Submission through Manual QA/QC Process – Space and Equipment

Avg. Time Spent Evaluating Design Schematic Drawings Against Design Requirements – Space and Equipment: The average time spent by Architect in validating Design Schematic drawings against space and equipment requirements before submission to Owners Rep.

- *Current Life Cycle Process:* Estimate 45 hours based on project analyzed. The Architect spent 4,498 hours total on this phase of the design. Assume 10% (449 hours) of the time allotted for internal checking of the entire document. 45 hours assumes that 10% of the allotted checking time is set aside for checking space and equipment requirements.
- **Expected Life Cycle Process:** Estimate 4.5 hours based on the reduction factor times the Current Life Cycle Process estimate.

090.06.10 Make Corrections (Architect and/or Consultants)

Avg. Time spent making corrections due to non-conformance with Space or Product Program: The average time spent by Architect making corrections to space and equipment documentation based on internal validation.

- Current Life Cycle Process: Estimate 4.5 hours based on number comments received related to space and equipment (13) on project analyzed. Assume 5 minutes per comment.
- Expected Life Cycle Process: Estimate 0 hours based on the reduction factor times the Current Life Cycle Process estimate.

090.06.20 Copy Design Schematic Documents and Product Type Templates (Outline Specifications) Documents

Avg. Number of Sheets in Design Schematic Drawings: The average number of Design Schematic (Design Development) drawings.

- Current Life Cycle Process: Estimate 480 based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Schematic Narrative: The average number of letter-sized pages in the Design Schematic narrative.

- **Current Life Cycle Process:** Estimate 40 total pages based on number of narrative topics (10) identified in UFC documentation. This assumes four pages per topic at this stage in the process.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Schematic Specifica-

tions: The average number of letter-sized pages in the Design Schematic specifications.

- Current Life Cycle Process: Estimate 9 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Design Submittal Sets Required: The number of design phase drawing sets required.

- *Current Life Cycle Process:* Estimate 3 total sets based on project analyzed.
- Expected Life Cycle Process: Estimate 0 sets based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time spent printing documents.

- Current Life Cycle Process: Estimate 1.35 hours per set based on printer specifications provided in the Printing Variables section of this appendix.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Specifications) Documents

Avg. Number of Transmittals: The average number of times documents are sent by the Architect to the Owner.

- Current Life Cycle Process: Estimate 2 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Architect Rep to Owner's Rep.

- Current Life Cycle Process: Estimate \$72.83 based on actual shipping cost in project analyzed.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

090.06.40 Log Transmittal of Design Schematic and Product Type Templates (Outline Specifications) Documents

Avg. Number of Transmittals: The average number of times documents are logged out by the Architect.

- Current Life Cycle Process: Estimate 2 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

090.08 Log Receipt of Design Schematic and Product Type Templates (Outline Specifications) Documents

Avg. Number of Transmittals: The average number of times documents are received by the Owner's Rep. from the Architect times the number of recipients for each exchange.

- *Current Life Cycle Process:* Estimate 2 based number of times Design Schematic Documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

090.09 Validate Design Schematic Space and Product Type Templates (Outline Specifications) Documents

Avg. Time to Review Design Schematic Drawings for conformance to Space and Product Program: The average time spent by Owner's Rep. in validating Space and Product Type Templates (Outline Specifications) in Schematic Documents provided by Architect.

- Current Life Cycle Process: Estimate 40 hours based on number drawings in Design Schematic Documents in project analyzed. Assume 15 minutes per drawing or 120 hours total time. Assume 1/3 of this time allotted for checking space and equipment requirements.
- **Expected Life Cycle Process:** Estimate 4 hours based on the reduction factor times the Current Life Cycle Process estimate.

090.10.20 Send Comments to Design Team

Avg. Number of Transmittals: The average number of times comments are sent by the Owner's Rep. to the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of comments based on number of times documents were received in the project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Owner's Rep. to the Architect.

- *Current Life Cycle Process:* Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep. in compiling documents / comments for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

090.10.30 Log Transmittal of Comments

Avg. Number of Transmittals: The average number of times documents / comments are sent by the Owner's Rep. to the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times comments were sent on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

090.12 Log Receipt of Comments

Avg. Number of Transmittals: The average number of times documents / comments are received by the Architect from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times comments were received on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

090.13 Make Corrections (Architect and/or Consultants)

Avg. Time Spent Making Corrections Due to Non-conformance with Space or Product Program: The average time spent by Architect making corrections to space and equipment documentation based on feedback from Owners Rep.

- Current Life Cycle Process: Estimate 4.5 hours based on number comments received related to space and equipment (54) on project analyzed. Assume 5 minutes per comment.
- Expected Life Cycle Process: Estimate 0 hours based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The Average number of times documentation is examined.

- **Current Life Cycle Process:** Estimate 2 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

090.14 Copy Revised Design Schematic and Product Type Templates (Outline Specifications) Documents

Reference variables in section 090.06.20 Copy Design Schematic Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

090.15 Send Revised Design Schematic and Product Type Templates (Outline Specifications) Documents

Reference variables in section 090.06.30 Send Design Schematic Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

090.16 Log Transmittal of Revised Design Schematic and Product Type Templates (Outline Specifications) Documents

Reference variables in section 090.06.40 Log Transmittal of Design Schematic Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

090.18 Log Receipt of Revised Design Schematic and Product Type Template (Outline Specifications) Documents

Reference variables in section 090.08 Log Receipt of Design Schematic Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

090.19 Validate Revised Design Schematic Space and Product Type Template (Outline Specifications) Documents

Reference variables in section 090.09 Validate Design Schematic & Product Type Template Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

090.20 Send Comments to Design Team

Reference variables in section 090.10.20 Send Comments to Design Team, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

090.21 Log Transmittal of Comments

Reference variables in section 090.10.30 Log Transmittal of Comments, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

090.23 Log Receipt of Comments

Reference variables in section 090.12 Log Receipt of Comments, in addition uses variable Avg. Number of Re-Submit Cycles from 090.13 Make Corrections (Architect and/or Consultants).

Develop Design – Design Coordinated: 100 Design Coordinated

100.02.10 Produce Design Coordinated Documents

Avg. Number of Plan Drawings in Design Coordinated Drawings: Average number of plans in submittal.

- Current Life Cycle Process: Estimate 52 based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. QTO Time for Equipment Components: The average time spent performing quantity take-off of equipment shown on plan drawings.

 Current Life Cycle Process: Estimate 5 minutes per plan drawing based on information obtained from project analyzed. Expected Life Cycle Process: Estimate 30 seconds based on the reduction factor times the Current Life Cycle Process estimate.

Avg. QTO Time for Spaces in Building: The average time spent performing quantity take-off of spaces shown on plan drawings.

- Current Life Cycle Process: Estimate 10 minutes per plan drawing based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 1 minute based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Time Spent by Licensed Professional Architect: Percentage of time spent by Licensed Architect to perform quantity take-off of all equipment and to calculate space areas shown on plan drawings.

- Current Life Cycle Process: Estimate 80% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Architect Drafter: Percentage of time spent by Architectural Drafter to perform quantity take-off of all equipment and to calculate space areas shown on plan drawings.

- Current Life Cycle Process: Estimate 20% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

100.02.20 Produce Detailed Specification / Product Type Templates

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Developing Detailed Equipment (products) Type

Templates: The average time spent by Architect in preparing a detailed specifications list based on equipment types

- Current Life Cycle Process: Estimate 2 hours per product type. Assume 85 product types based on project analyzed.
- Expected Life Cycle Process: Estimate 36 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.03 Search for Product Type Candidates

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Searching for Product Literature for Candidates: The average time spent by Architect in searching for product data.

- Current Life Cycle Process: Estimate 1 hour per product type based on experience searching for product data on recent project.
- Expected Life Cycle Process: Estimate 6 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.06 Validate Checkset Before Submission Through Manual QA/QC Process – Space and Equipment

Avg. Time Spent Evaluating Design Coordinated Drawings Against Design Requirements – Space and Equipment: The average time spent by Architect in validating Design Coordinated drawings against space and equipment requirements before submission to Owners Rep.

- Current Life Cycle Process: Estimate 52 hours based on project analyzed. The Architect spent 5,214 hours total on this phase of the design. Assume 10% (521 hours) of the time allotted for internal checking of the entire document. 52 hours assumes that 10% of the allotted checking time is set aside for checking space and equipment requirements.
- **Expected Life Cycle Process:** Estimate 5.2 hours based on the reduction factor times the Current Life Cycle Process estimate.

100.07.05 Make Corrections (Architect and/or Consultants)

Avg. Time Spent Making Corrections due to Non-Conformance with Space Program: The average time spent by Architect making corrections to space and equipment documentation based on internal validation.

- Current Life Cycle Process: Estimate 7.75 hours based on number comments received project analyzed. Assume 5 minutes per comment.
- **Expected Life Cycle Process:** Estimate 0 hours based on the reduction factor times the Current Life Cycle Process estimate.

100.07.10 Re-Search and Recreate Product Type Candidates and Detailed Specifications Based on QA/QC Results

Avg. Percent of Errors in Product Type Candidate: The average percentage of errors with product specification information.

- *Current Life Cycle Process:* Estimate that roughly 15% or 13% of the 85 specifications would have errors at this stage.
- **Expected Life Cycle Process:** Estimate 0% based on the reduction factor times the Current Life Cycle Process estimate.

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Searching for Product Literature for Candidates: The average time spent by Architect in searching for product data.

- Current Life Cycle Process: Estimate 1 hour per product type based on experience performing additional searches for product data on recent project.
- Expected Life Cycle Process: Estimate 6 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.07.20 Copy Design Coordinated and Product Type Candidate Documents

Avg. Number of Sheets in Design Coordinated Drawings: The average number of Design Coordinated drawings.

- Current Life Cycle Process: Estimate 626 based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Coordinated Narrative:

The average number of letter-sized pages in the Design Coordinated narrative.

- **Current Life Cycle Process:** Estimate 40 total pages based on number of narrative topics (10) identified in UFC documentation. This assumes four pages per topic at this stage in the process.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Coordinated Specifica-

tions: The average number of letter-sized pages in the Design Coordinated specifications.

- *Current Life Cycle Process:* Estimate 9 pages based on project analyzed. No additional specifications were included with this submission.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Design Submittal Sets Required: The number of design phase drawing sets required.

- *Current Life Cycle Process:* Estimate 3 total sets based on project analyzed.
- **Expected Life Cycle Process:** Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time spent printing documents.

- Current Life Cycle Process: Estimate 2 hours per set based on printer specifications provided in the Printing Variables section of this appendix.
- Expected Life Cycle Process: Estimate 0 hours based on the reduction factor times the Current Life Cycle Process estimate.

100.07.30 Send Design Coordinated and Product Type Candidate Documents

Avg. Number of Transmittals: The average number of times documents are sent by the Architect to the Owner.

- Current Life Cycle Process: Estimate 2 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Architect Rep to Owner's Rep.

- Current Life Cycle Process: Estimate \$76.81 based on actual shipping cost in project analyzed.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.07.40 Log Transmittal of Design Coordinated and Product Type Candidate Documents

Avg. Number of Transmittals: The average number of times documents are logged out by the Architect.

- Current Life Cycle Process: Estimate 2 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.09 Log Receipt of Design Coordinated and Product Type Candidate Documents

Avg. Number of Transmittals: The average number of times documents are received by the Owner's Rep. from the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based number of times Design Coordinated Documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.10 Validate Design Coordinated Space and Product Type Candidates

Avg. Time to Review Design Coordinated Drawings for conformance to Space and Product Program: The average time spent by Owner's Rep. in validating Space and Product Type Candidates in Schematic Coordinated Drawings provided by Architect.

• Current Life Cycle Process: Estimate 52 hours based on number drawings in Design Coordinated Documents in project analyzed. Assume 15 minutes per drawing or 156 hours total time. Assume 1/3 of this time allotted for checking space and equipment requirements.

• **Expected Life Cycle Process:** Estimate 5.2 hours based on the reduction factor times the Current Life Cycle Process estimate.

100.11.20 Send Comments to Design Team

Avg. Number of Transmittals: The average number of times comments are sent by the Owner's Rep. to the Architect times the number of recipients for each exchange.

- **Current Life Cycle Process:** Estimate 2 transmittals of comments based on number of times documents were received in the project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Owner's Rep. to the Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate- based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep. in compiling documents / comments for transmittal.

- *Current Life Cycle Process:* Estimate 30 minutes for this task.
- **Expected Life Cycle Process:** Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.11.30 Log Transmittal of Comments

Avg. Number of Transmittals: The average number of times documents / comments are sent by the Owner's Rep. to the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times comments were sent on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.13 Log Receipt of Comments

Avg. Number of Transmittals: The average number of times documents / comments are received by the Architect from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 based on number of times comments were received on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents / comments in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

100.14 Make Corrections (Architect and/or Consultants)

Avg. Time Spent Making Corrections Due to Non-Conformance with Space Program: The average time spent by Architect making corrections to space and equipment documentation based on feedback from the Owner.

- **Current Life Cycle Process:** Estimate 7.75 hours based on number comments received related to space and equipment (93) on project analyzed. Assume 5 minutes per comment.
- **Expected Life Cycle Process:** Estimate 0 hours based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Re-Submit Cycles: The Average number of times documentation is examined.

- *Current Life Cycle Process:* Estimate 2 based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

100.15 Copy Revised Design Coordinated and Product Type Candidate Documents

Reference variables in section 100.07.20 Copy Design Coordinated Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14 Make Corrections (Architect and/or Consultants).

100.16 Send Revised Design Coordinated and Product Type Candidate Documents

Reference variables in section 100.07.30 Send Design Coordinated Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14

100.17 Log Transmittal of Revised Design Coordinated and Product Type Candidate Documents

Reference variables in section 100.07.40 Log Transmittal of Design Coordinated Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14

100.19 Log Receipt of Revised Design Coordinated and Product Type Candidate Documents

Reference variables in section 100.09 Log Receipt of Design Coordinated Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14

100.20 Validate Revised Design Coordinated and Product Type Candidate Documents

Reference variables in section 100.10 Validate Design Coordinated & Product Type Template Documents, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14

100.21 Send Comments to Design Team

Reference variables in section 100.11.20 Send Comments to Design Team, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14

100.22 Log Transmittal of Comments

Reference variables in section 100.11.30 Log Transmittal of Comments, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14

100.24 Log Receipt of Comments

Reference variables in section 100.13 Log Receipt of Comments, in addition uses variable Avg. Number of Re-Submit Cycles from 100.14

Finalize Design - Design Final: 110 Design Final

110.02.10 Produce Design Final Documents

Avg. Number of Plan Drawings in Design Final Drawings: Average number of plans in submittal.

- Current Life Cycle Process: Estimate 164 based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. QTO Time for Equipment Components: The average time spent performing quantity take-off of equipment shown on plan drawings.

- Current Life Cycle Process: Estimate 5 minutes per drawing plan based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 30 seconds based on the reduction factor times the Current Life Cycle Process estimate.

Avg. QTO Time for Spaces in Building: The average time spent performing quantity take-off of spaces shown on plan drawings.

- Current Life Cycle Process: Estimate 10 minutes per drawing plan based on information obtained from project analyzed.
- **Expected Life Cycle Process:** Estimate 1 minute based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Time Spent by Licensed Professional Architect: Percentage of time spent by Licensed Architect to perform quantity take-off of all equipment and to calculate space areas shown on plan drawings.

- Current Life Cycle Process: Estimate 90% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Architect Drafter: Percentage of time spent by Architectural Drafter to perform quantity take-off of all equipment and to calculate space areas shown on plan drawings.

- Current Life Cycle Process: Estimate 10% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

110.02.20 Produce Detailed Specification / Product Type Candidates

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Developing Detailed (products) Equipment Type Candidate: Time spent by Architect in preparing a detailed specifications list bases on equipment.

- Current Life Cycle Process: Estimate 1 hour per product type. Assume 85 product types based on project analyzed.
- **Expected Life Cycle Process:** Estimate 6 minutes per product type based on the reduction factor times the Current Life Cycle Process estimate.

110.05 Validate Checkset Before Submission Through Manual QA/QC Process

Avg. Time Spent Evaluating Design Final Drawings Against Design Requirements – Space and Equipment: The average time spent by Licensed Architect validating Space Program and Equipment Types before submission to Owner's Rep.

- Current Life Cycle Process: Estimate 48 hours based on project analyzed. The Architect spent 4,801 hours total on this phase of the design. Assume 10% (480 hours) of the time allotted for internal checking of the entire document. 48 hours assumes that 10% of the allotted checking time is set aside for checking space and equipment requirements.
- **Expected Life Cycle Process:** Estimate 4.8 hours based on the reduction factor times the Current Life Cycle Process estimate.

110.06.10 Make Corrections (Architect and/or Consultants)

Avg. Time Spent Making Corrections due to Non-Conformance with Space or Product Program: The average time spent by Architect making corrections to space and equipment documentation based on internal validation.

- Current Life Cycle Process: Estimate 1 hour based on number comments received related to space and equipment (13) on project analyzed.
 Assume 5 minutes per comment.
- Expected Life Cycle Process: Estimate 0 hours based on the reduction factor times the Current Life Cycle Process estimate.

110.06.20 Copy Design Final Documents

Avg. Number of Sheets in Design Final Drawings: The average number of Design Final drawing.

- Current Life Cycle Process: Estimate 899 based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Final Narrative: The average number of letter-sized pages in the Design Final narrative.

- Current Life Cycle Process: Estimate 40 total pages based on number of narrative topics (10) identified in UFC documentation. This assumes four pages per topic at this stage in the process.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Final Specifications: The average number of letter-sized pages in the Design Final specifications.

- Current Life Cycle Process: Estimate 1,635 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Design Submittal Sets Required: The number of design phase drawing sets required.

- Current Life Cycle Process: Estimate 3 total sets based on project analyzed.
- **Expected Life Cycle Process:** Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time spent printing documents.

- *Current Life Cycle Process:* Estimate 3.20 hours per set based on printer specifications provided in the *Printing Variables* section of this appendix.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

110.06.30 Send Design Final Documents

Avg. Number of Transmittals: The average number of times documents are sent by the Architect to the Owner.

- Current Life Cycle Process: Estimate 1 transmittal based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Architect Rep to Owner's Rep.

- Current Life Cycle Process: Estimate \$249.15 utilizing fed-ex standard overnight rates for weight of printed documents in project analyzed.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- **Expected Life Cycle Process:** Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

110.06.40 Log Transmittal of Design Final Documents

Avg. Number of Transmittals: The average number of times documents are logged out by the Architect.

- Current Life Cycle Process: Estimate 1 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

110.08 Log Receipt of Design Final Documents for Bidding Process

Avg. Number of Transmittals: The average number of times documents are received by the Owner's Rep. from the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 1 based number of times Design Final Documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Prepare Invitation to Bid (Post Design): 120 Request for Proposal

120.01 Receive Information from A/E to Develop Bid Documents

Time to Log: The time spent logging documents.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

120.03 Copy Request for Proposal (RFP) Package

Avg. Number of Pages in Front Matter: The average number of pages that precede the technical content of the RFP for Design and Construction Services.

- Current Life Cycle Process: Estimate 25 pages.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sheets in Design Final Drawings: The average number of drawing sheets.

- Current Life Cycle Process: Estimate 899 based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Final Narrative: The average number of pages included in the Design Final narrative.

- *Current Life Cycle Process:* Estimate 40 total pages based on number of narrative topics (10) identified in UFC documentation. This assumes four pages per topic at this stage in the process.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Letter-Sized Pages in Design Final Specification: The average number of pages included in the Design Final specifications.

- Current Life Cycle Process: Estimate 1,635 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Request for Proposal Submittal Sets Required: The average number printed sets required.

 Current Life Cycle Process: Estimate 5 total sets. Assume an average of 5 total bidders. Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time spent printing documents.

- Current Life Cycle Process: Estimate 3.21 hours per set based on printer specifications provided in the Printing Variables section of this appendix.
- **Expected Life Cycle Process:** Estimate 0 hours based on the reduction factor times the Current Life Cycle Process estimate.

120.04 Send Request for Proposal (RFP) Package

Avg. Number of Transmittals: The average number of times Proposal is sent by the Owner's Rep. to Bidders.

- *Current Life Cycle Process:* Estimate 5 transmittals of RFP.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents sent by Owner's Rep to Bidders.

- *Current Life Cycle Process:* Estimate \$249.00 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner compiling documents for transmittal.

- **Current Life Cycle Process:** Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Respond to Pre-Proposal Inquiries: 130 Inquiry Issue

130.04 Send Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times Inquiry Issues and responses are sent and received between Owner's Rep, Architect and Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based on actual number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents to the Owner's Rep. from the Contractor.

- Current Life Cycle Process: Estimate \$16.50 utilizing fed-ex standard overnight rates. Estimate 10 letter sized pages each transmittal.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues: The average time spent by Contractor compiling documents for transmittal.

- Current Life Cycle Process: Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.05 Log Transmittal of Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times documents are logged out by the Contractor.

- Current Life Cycle Process: Estimate 3 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by the Contractor logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.07 Log Receipt of Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times documents are received by the Owner's Rep. from the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.08 Send Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times Inquiry Issues are forwarded to the Architect from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based on actual number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents/comments sent between Owner's Rep. to the Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing fed-ex standard overnight rates.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues: The average time spent by Owner's Rep. compiling documents for transmittal.

- *Current Life Cycle Process:* Estimate 2 minutes for this task.
- Expected Life Cycle Process: Estimate 45 seconds based on the reduction factor times the Current Life Cycle Process estimate.

130.09 Log Transmittal of Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times documents are logged out by the Owner's Rep.

- Current Life Cycle Process: Estimate 3 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by the Owner's Rep. logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.11 Log Receipt of Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times documents are received by the Architect from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by Architect logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.13 Send Inquiry Issue (Clarification) Response

Avg. Number of Transmittals: The average number of times Inquiry Issues responses are sent from Architect to Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based on actual number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents to the Owner's Rep. from the Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing fed-ex standard overnight rates. Estimate 10 letter sized pages each transmittal.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues: The average time spent by Architect compiling documents for transmittal.

- *Current Life Cycle Process:* Estimate 15 minutes for this task.
- **Expected Life Cycle Process:** Estimate 6 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.14 Log Transmittal of Response of Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times documents are logged out by the Architect.

- Current Life Cycle Process: Estimate 3 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by the Architect logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.16 Log Receipt of Response of Inquiry Issue (Clarification)

Avg. Number of Transmittals: The average number of times documents are received by the Owner's Rep. from the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.18 Send Inquiry Issue (Clarification) Response to Contractor

Avg. Number of Transmittals: The average number of times Inquiry Issues are forwarded to the Contractor from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based on actual number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents/comments sent between Owner's Rep. to the Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing fed-ex standard overnight rates.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues: The average time spent by Owner's Rep. compiling documents for transmittal.

- Current Life Cycle Process: Estimate 2 minutes for this task.
- Expected Life Cycle Process: Estimate 45 seconds based on the reduction factor times the Current Life Cycle Process estimate.

130.19 Log Transmittal of Inquiry Issue (Clarification) Response

Avg. Number of Transmittals: The average number of times documents are logged out by the Owner's Rep.

- Current Life Cycle Process: Estimate 3 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by the Owner's Rep. logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

130.21 Log Receipt of Inquiry Issue (Clarification) Response

Avg. Number of Transmittals: The average number of times documents are received by the Contractor from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 3 based number of addenda in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by the Contractor logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Identify Discrepancies: 150 Inquiry Issue (RFI)

150.04 Send Inquiry Issue (RFI) related to Space and Equipment

Avg. Number of RFIs: The average number of formal questions (Request for Information) initiated by the Contractor related to Space and Equipment.

- Current Life Cycle Process: Estimate 160 based on actual number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents to the Owner's Rep. from the Contractor.

- Current Life Cycle Process: Estimate \$16.50 utilizing fed-ex standard overnight rates.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues (RFI): The aver-

age time spent by Contractor compiling documents for transmittal.

- Current Life Cycle Process: Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.05 Log Transmittal of Inquiry Issue (RFI)

Avg. Number of RFIs: The average number of times documents are logged out by the Contractor.

- Current Life Cycle Process: Estimate 160 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by the Contractor logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.07 Log Receipt of Inquiry Issue (RFI)

Avg. Number of RFIs: The average number of times documents are received by the Owner's Rep. from the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 160 based on number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.08 Send Inquiry Issue (RFI) to Architect

Avg. Number of RFIs: The average number of times Inquiry Issues are forwarded to the Architect from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 160 based on actual number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents/comments sent between Owner's Rep. to the Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing fed-ex standard overnight rates.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues (RFI): The average time spent by Owner's Rep. compiling documents for transmittal.

- Current Life Cycle Process: Estimate 2 minutes for this task.
- Expected Life Cycle Process: Estimate 45 seconds based on the reduction factor times the Current Life Cycle Process estimate.

150.09 Log Transmittal of Inquiry Issue (RFI)

Avg. Number of RFIs: The average number of times documents are logged out by the Owner's Rep.

- Current Life Cycle Process: Estimate 160 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by the Owner's Rep. logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.11 Log Receipt of Inquiry Issue (RFI)

Avg. Number of RFIs: The average number of times documents are received by the Architect from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 160 based number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by Architect logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.13 Send Inquiry Issue (RFI) Response

Avg. Number of RFIs: The average number of times Inquiry Issues responses are sent from Architect to Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 160 based on actual number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents to the Owner's Rep. from the Architect.

- **Current Life Cycle Process:** Estimate \$16.50 utilizing fed-ex standard overnight rates. Estimate 10 letter sized pages each transmittal.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues (RFI): The average time spent by Architect compiling documents for transmittal.

- Current Life Cycle Process: Estimate 10 minutes for this task.
- Expected Life Cycle Process: Estimate 4 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.14 Log Transmittal of Inquiry Issue (RFI) Response

Avg. Number of RFIs: The average number of times documents are logged out by the Architect.

- Current Life Cycle Process: Estimate 160 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by the Architect logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.16 Log Receipt of Response of Inquiry Issue (RFI)

Avg. Number of RFIs: The average number of times documents are received by the Owner's Rep. from the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 160 based number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent by Owner's Rep. logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.18 Send Inquiry Issue (RFI) Response to Contractor

Avg. Number of RFIs: The average number of times Inquiry Issues are forwarded to the Contractor from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 160 based on actual number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for mailing documents/comments sent between Owner's Rep. to the Architect.

- **Current Life Cycle Process:** Estimate \$16.50 utilizing fed-ex standard overnight rates. Estimate 10 letter sized pages each transmittal.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare Transmittals for Inquiry Issues (RFI): The average time spent by Owner's Rep. compiling documents for transmittal.

- Current Life Cycle Process: Estimate 2 minutes for this task.
- Expected Life Cycle Process: Estimate 45 seconds based on the reduction factor times the Current Life Cycle Process estimate.

150.19 Log Transmittal of Inquiry Issue (RFI) Response

Avg. Number of RFIs: The average number of times documents are logged out by the Owner's Rep.

- Current Life Cycle Process: Estimate 160 based on number of times documents were sent in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by the Owner's Rep. logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare comments, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

150.21 Log Receipt of Inquiry Issue (RFI) Response

Avg. Number of RFIs: The average number of times documents are received by the Contractor from the Owner's Rep. times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 160 based on number of RFI's in project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent by the Contractor logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Organize Submittal Information: 180 Submittal Package

180.02.15 Log Receipt of Product Data from Sub-Contractors and Vendors

Avg. Number of Transmittals: The average number of product submittal items sent by the Sub-Contractors and vendors to the Contractor.

- Current Life Cycle Process: Estimate 252 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- **Expected Life Cycle Process:** Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.02.20 Produce Submittal Information

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Organizing Equipment (Product) Type Information:

The average time spent by Assistant Project Manager in producing submittal packages by organizing equipment type information.

- *Current Life Cycle Process:* Estimate 30 minutes per submittal item based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.03 Validate Submittal Information Against Contract Documents

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Evaluating Equipment (Product) Type Submittal

Items Against Contract Documents: The average time spent by Construction Project Manager and Assistant Project Manager evaluating submittal items.

- Current Life Cycle Process: Estimate 1 hour per submittal item based on
- **Expected Life Cycle Process:** Estimate 6 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Submittal Items Rejected: The percentage of submittal items rejected.

Current Life Cycle Process: Estimate 20%.

information obtained from project analyzed.

Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Construction Project Manager: The percentage of time spent by Project Manager in validating submittal information.

- **Current Life Cycle Process:** Estimate 10% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Assistant (Construction) Project Manag-

er: The percentage of time spent by Assistant Project Manager in validating submittal information.

- Current Life Cycle Process: Estimate 90% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

180.05 Copy Submittal Package

Avg. Number of Submittal Pages in a Submittal Item: The average number of letter-sized pages per submittal item.

- Current Life Cycle Process: Estimate 18 pages based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Submittal Sheets in a Submittal Item: The average number of drawings per submittal item.

- **Current Life Cycle Process:** Estimate 2 sheets based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Submittal Items in a Product Submittal Package: The average number of product Items per submittal package.

- Current Life Cycle Process: Estimate 3 items based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Unique Product Types: The average number of equipment types found in building.

Current Life Cycle Process: Estimate 85 equipment types based on information obtained from project analyzed.

Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Submittal Sets Required: The number of construction phase submittal sets required.

- Current Life Cycle Process: Estimate 3 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time spent printing documents.

- Current Life Cycle Process: Estimate 1 minute per set based on printer specifications provided in the Printing Variables section of this appendix.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.06 Stamp Submittal Package

Avg. Number of Submittal Pages in a Submittal Item: The average number of letter-sized pages per submittal item.

- *Current Life Cycle Process:* Estimate 18 pages based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Submittal Sheets in a Submittal Item: The average number of drawings per submittal item.

- **Current Life Cycle Process:** Estimate 2 sheets based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Submittal Items in a Product Submittal Package: The average number of product Items per submittal package.

- Current Life Cycle Process: Estimate 3 items based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Submittal Sets Required: The number of construction phase submittal sets required.

• *Current Life Cycle Process:* Estimate 3 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.

 Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Sign Each Page: The average time spent by Construction Project Manager in signing each page.

- Current Life Cycle Process: Estimate 5 seconds per page based on information obtained from project analyzed.
- **Expected Life Cycle Process:** Estimate 0 seconds based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Stamp Each Sheet: The average time spent by Assistant Project Manager in stamping each page.

- Current Life Cycle Process: Estimate 5 seconds per sheet based on information obtained from project analyzed.
- **Expected Life Cycle Process:** Estimate 0 seconds based on the reduction factor times the Current Life Cycle Process estimate.

180.07 Send Submittal Package

Avg. Number of Transmittals: The average number of times a submittal is sent by the Contractor to the Owner's Rep times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 252 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Contractor and Owner's Rep.

- *Current Life Cycle Process:* Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect Drafter in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 5 minutes for this task.
- Expected Life Cycle Process: Estimate 2 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.08 Log Transmittal of Submittal Package

Avg. Number of Transmittals: The average number of times a submittal is sent by the Contractor to the Owner's Rep times the number of recipients for

each exchange.

- Current Life Cycle Process: Estimate 252 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.10 Log Receipt of Submittal Package

Avg. Number of Transmittals: The average number of times a submittal is sent by the Contractor to the Owner's Rep times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 252 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.12 Send Submittal Package to Architect

Avg. Number of Transmittals: The average number of times a submittal is sent by the Owner's Rep to the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 252 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Owner's Rep and Architect.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Owner's Rep in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 5 minutes for this task.
- Expected Life Cycle Process: Estimate 2 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.13 Log Transmittal of Submittal Package

Avg. Number of Transmittals: The average number of times a submittal is sent by the Owner's Rep to the Architect times the number of recipients for each exchange.

- **Current Life Cycle Process:** Estimate 252 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

180.15 Log Receipt of Submittal Package

Avg. Number of Transmittals: The average number of times a submittal is sent by the Owner's Rep to the Architect times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 252 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Perform Submittal Review: 190 Submittal Issue

190.02.10 Send Copies of Submittal Package (Product Type Selection,

System Layout) to Sub-Consultants

Avg. Number of Transmittals: The average number of times a submittal is sent by the Architect Drafter to the Sub-Consultants times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 6 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Architect and Sub-Consultants.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect Drafter in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- Expected Life Cycle Process: Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

190.02.11 Log Transmittal of Submittal Package (Product Type Selection, System Layout)

Avg. Number of Transmittals: The average number of times a submittal is sent by the Architect Drafter to the Sub-Consultants times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 6 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

190.02.13 Log Receipt of Sub Consultants Submittals Markups/Comments

Avg. Number of Transmittals: The average number of times a submittal is

sent by the Architect Drafter to the Sub-Consultants times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 6 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

190.02.20 Validate Submittal Packages Not Sent to Sub-Consultants

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Evaluating Product Type Submittal Items Against Contract Documents: The average time spent by Licensed Architect in evaluating submittals.

- Current Life Cycle Process: Estimate 1 hour based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 6 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Product Submittals Reviewed by Licensed Architect:

The percentage of submittals that are product related reviewed by a Licensed Architect.

- Current Life Cycle Process: Estimate 8% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

190.02.21 Mark-up Copies of Submittals with Comments

Avg. Number of Submittal Pages in a Submittal Item: The average number of letter-sized pages per submittal item.

Current Life Cycle Process: Estimate 18 pages based on information obtained from project analyzed.

Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Submittal Sheets in a Submittal Item: The average number of drawings per submittal item.

- Current Life Cycle Process: Estimate 2 sheets based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Submittal Items in a Submittal Package for Each Equipment (Product) Type: The average number of product Items per submittal package.

- Current Life Cycle Process: Estimate 3 items based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Transferring Comments per Page: The average time spent by Architect Drafter in marking up submittal with comments.

- Current Life Cycle Process: Estimate 2 minutes per page based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time Spent Transferring Comments per Sheet: The average time spent by Architect Drafter in marking up submittal with comments.

- Current Life Cycle Process: Estimate 5 minutes per sheet based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Number of Submittal Sets Required: The number of construction phase submittal sets required.

- Current Life Cycle Process: Estimate 3 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

190.03.10 Send Copies of Submittal Issues

Avg. Number of Transmittals: The average number of times a submittal is sent by the Architect Drafter to the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 6 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Architect and Contractor.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Architect Drafter in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- **Expected Life Cycle Process:** Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

190.03.20 Log Transmittal of Submittal Issues

Avg. Number of Transmittals: The average number of times a submittal is sent by the Architect Drafter to the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 6 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

190.05 Log Receipt of Submittal Issues

Avg. Number of Transmittals: The average number of times a submittal is

sent by the Licensed Architect to the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 6 transmittals based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

190.06.10 Recreate Submittal Package (Product Type Selection, System Layout)

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Revising One Product Submittal Item: The average time spent by Contractor recreating Submittal Items.

- Current Life Cycle Process: Estimate 1 hour per product based on information obtained from project analyzed.
- Expected Life Cycle Process: Estimate 6 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Time Spent by Construction Project Manager: The percentage of time spent by Project Manager in recreating Submittal Package.

- Current Life Cycle Process: Estimate 80% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Assistant (Construction) Project Manag-

er: The percentage of time spent by Assistant Project Manager in recreating Submittal Package.

- Current Life Cycle Process: Estimate 20% based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

190.07 2nd Review Cycle of Submittal Package (Product Type Selection, System Layout)

Percentage of Product Submittals rejected on 2nd Review: The percentage of submittals rejected upon review.

- **Current Life Cycle Process:** Estimate 43% based on information obtained from project analyzed.
- **Expected Life Cycle Process:** Estimate 4.3% based on the reduction factor times the Current Life Cycle Process estimate.

190.08 3rd Review Cycle of Submittal Package (Product Type Selection, System Layout)

Percentage of Product Submittals rejected on 3rd Review: The percentage of submittals rejected upon review.

- **Current Life Cycle Process:** Estimate 25% based on information obtained from project analyzed.
- **Expected Life Cycle Process:** Estimate 0% based on the reduction factor times the Current Life Cycle Process estimate.

190.09 4th Review Cycle of Submittal Package (Product Type Selection, System Layout)

Percentage of Product Submittals rejected on 4th Review: The percentage of submittals rejected upon review.

- *Current Life Cycle Process:* Estimate 8% based on information obtained from project analyzed.
- **Expected Life Cycle Process:** Estimate 0% based on the reduction factor times the Current Life Cycle Process estimate.

Execute Construction Activities: 210 Product Installation

210.04 Reformat Product Installation Report

Number of Tagged Components: Total number of pieces of equipment that will have asset tags and will be managed by the owner.

- **Current Life Cycle Process:** Estimate 534 based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Re-formatting Product Installation Report in Office:

Average time spent by Contractor in the office re-formatting report.

- Current Life Cycle Process: Estimate 20 minutes based on project analyzed.
- **Expected Life Cycle Process:** Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

210.05 Send Product Installation Report

Avg. Number of Transmittals: The average number of times a report is sent by the Contractor to the Architect / Owner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Contractor and Architect / Owner.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Contractor in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 5 minutes for this task.
- Expected Life Cycle Process: Estimate 2 minutes based on the reduction factor times the Current Life Cycle Process estimate.

210.06 Log Transmittal of Product Installation Report

Avg. Number of Transmittals: The average number of times a report is sent by the Contractor to the Architect / Owner times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

210.08 Log Receipt of Product Installation Report

Avg. Number of Transmittals: The average number of times a report is sent by the Licensed Architect to the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Inspect and Approve Work: 230 Product Inspection

230.04 Reformat Product Inspection

Avg. Field Time Spent Documenting Report per Site Visit: The average time spent by a Licensed Architect in the field documenting data related to Installed Components.

- Current Life Cycle Process: Estimate 2.75 hours per visit based on project analyzed.
- **Expected Life Cycle Process:** Estimate 1.1 hours based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Site Visits per Month: The average number of times a Licensed Architect visits the site a month in order to inspect Installed Components.

- Current Life Cycle Process: Estimate 4 times per month based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Months of Construction: The average duration of the construction phase of a project.

- Current Life Cycle Process: Estimate 45 months based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Total Time Spent in the Office: The time spent in the office on a daily basis.

- Current Life Cycle Process: Estimate 8 hours a day based on industry standards.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Percentage of Office Time Spent Quantifying Products-in-Place:

The average percentage of office time spent by Licensed Architect formatting

Product Inspection Report.

- Current Life Cycle Process: Estimate 75% of Total time spent in the office.
- **Expected Life Cycle Process:** Estimate 7.5% based on the reduction factor times the Current Life Cycle Process estimate.

230.05 Send Product Inspection Report to Contractor

Avg. Number of Transmittals: The average number of times report is sent by the Licensed Architect to the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of Product Inspection Report.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Mailing Cost per Transmittal: The average cost for delivering the report between the Licensed Architect and Contractor.

- Current Life Cycle Process: Estimate \$16.50 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Licensed Architect in compiling documents for transmittal.

- **Current Life Cycle Process:** Estimate 5 minutes for this task.
- **Expected Life Cycle Process:** Estimate 2 minutes based on the reduction factor times the Current Life Cycle Process estimate.

230.06 Log Transmittal of Product Inspection Report

Avg. Number of Transmittals: The average number of times a report is sent by the Licensed Architect to the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of Product Inspection Report.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

230.08 Log Receipt of Product Inspection Report

Avg. Number of Transmittals: The average number of times a report is sent by the Licensed Architect to the Contractor times the number of recipients for each exchange.

- Current Life Cycle Process: Estimate 2 transmittals of Product Inspection Report.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Time to Log: The average time spent logging documents in.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Close Out: 250 Turnover Package

250.01 Compile Turnover Package

Avg. Time Spent Searching and Assembling Operations & Mainte-

nance Manuals: The average time spent by Contractor in compiling the Operations and Maintenance Manual.

- Current Life Cycle Process: Estimate 3 hours per manual based on project analyzed.
- **Expected Life Cycle Process:** Estimate 18 minutes per manual based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time Spent Searching and Assembling Commissioning Report:

The average time spent by Contractor in compiling the Commissioning Report.

- Current Life Cycle Process: Estimate 30 minutes per report.
- **Expected Life Cycle Process:** Estimate 3 minutes per report based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time Spent Searching and Assembling Record Specifications: The

average time spent by Contractor in compiling the Record Specifications.

- Current Life Cycle Process: Estimate 1.5 hours per drawing based on project analyzed.
- **Expected Life Cycle Process:** Estimate 9 minutes per drawing based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Sheets in Record (As-Built) Drawings: The average number of drawing sheets in As-Built Drawings.

- Current Life Cycle Process: Estimate 1048 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Searching and Assembling Record (As-Built) Draw-

ings: The average time spent by Contractor in compiling As-Built Drawings.

- Current Life Cycle Process: Estimate 3 seconds per sheet based on project analyzed.
- Expected Life Cycle Process: Estimate 0 seconds per sheet based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Sheets in Final Approved Shop Drawings: The average number of drawing sheets in As-Built Drawings.

- *Current Life Cycle Process:* Estimate 2 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Searching and Assembling Final Approved Shop

Drawings: The average time spent by Contractor in compiling As-Built Drawings.

- Current Life Cycle Process: Estimate 30 seconds per sheet based on project analyzed.
- **Expected Life Cycle Process:** Estimate 3 seconds per sheet based on the reduction factor times the Current Life Cycle Process estimate.

Percentage of Time Spent by Construction Project Manager: The percentage of time spent by Project Manager in compiling all documents related to the Turnover Package.

- *Current Life Cycle Process:* Estimate 10% based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Percentage of Time Spent by Assistant (Construction) Project Manag-

er: The percentage of time spent by Assistant Project Manager in compiling all documents related to the Turnover Package.

- *Current Life Cycle Process:* Estimate 90% based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

250.02 Copy Turnover Package

Avg. Number of Pages In Operations & Maintenance Manuals: The average of pages in Operations and Maintenance Manual.

- Current Life Cycle Process: Estimate 3,580 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Unique Product Types: The average number of equipment types found in building.

- Current Life Cycle Process: Estimate 85 equipment types based on information obtained from project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages In Commissioning Report: The average of pages in Commission Report.

- Current Life Cycle Process: Estimate 10 pages per component.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Components & Systems to be Commissioned: The average number of components and systems in the building to be commissioned.

- *Current Life Cycle Process:* Estimate 0 components and systems. This information was unavailable for the project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages In Record Specifications: The average of pages in Record Specifications.

- Current Life Cycle Process: Estimate 1635 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sheets in Record (As-Built) Drawings: The average number of drawing sheets in As-Built Drawings.

- Current Life Cycle Process: Estimate 1048 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sheets in Final Approved Shop Drawings: The average number of drawing sheets in As-Built Drawings.

- Current Life Cycle Process: Estimate 2 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Number of Submittal Sets Required: The number of construction phase

submittal sets required.

- Current Life Cycle Process: Estimate 3 sets based on information in United Facility Criteria (UFC) documentation regarding participants involved in early planning activities.
- Expected Life Cycle Process: Estimate 0 based on the reduction factor times the Current Life Cycle Process estimate.

Avg. In-house Reproduction Time per Set: The average time required to print each set.

- Current Life Cycle Process: Estimate 9 hours per set assuming use of both small format and large format printers indentified above.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

250.03 Send Copies of Turnover Package

Avg. Mailing Cost per Transmittal: The average cost for delivering documents/comments sent between Contractor and Owner.

- Current Life Cycle Process: Estimate \$350 utilizing Fed-Ex's standard overnight shipping cost based on weight of documents.
- Expected Life Cycle Process: Estimate based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time to Prepare a Transmittal: The average time spent by Contractor in compiling documents for transmittal.

- Current Life Cycle Process: Estimate 30 minutes for this task.
- **Expected Life Cycle Process:** Estimate 12 minutes based on the reduction factor times the Current Life Cycle Process estimate.

250.04 Log Transmittal of Turnover Package

Time to Log: The time spent logging documents out.

- Current Life Cycle Process: Estimate 15 minutes for this task based on time to prepare package, verify information being sent, and enter into log spreadsheet.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

250.06 Log Receipt of Turnover Package

Time to Log: The time spent logging documents in.

 Current Life Cycle Process: Estimate 15 minutes for this task based on time to open package, verify information received, and enter into log spreadsheet. Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

250.07 Review Turnover Package

Avg. Number of Pages In Operations & Maintenance Manuals: The average of pages in Operations and Maintenance Manual.

- Current Life Cycle Process: Estimate 3,580 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Reviewing Operations & Maintenance Manuals: The average time spent by Owner in reviewing the Operations and Maintenance Manual.

- Current Life Cycle Process: Estimate 6 seconds per page based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages In Commissioning Report: The average of pages in Commission Report.

- Current Life Cycle Process: Estimate 10 pages.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Reviewing Commissioning Report: The average time spent Owner in reviewing the Commissioning Report.

- Current Life Cycle Process: Estimate 30 seconds per page.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Pages In Record Specifications: The average of pages in Record Specifications.

- Current Life Cycle Process: Estimate 1635 pages based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Reviewing Record Specifications: The average time spent by Owner in reviewing the Record Specifications.

- Current Life Cycle Process: Estimate 6 seconds per page based on project analyzed.
- **Expected Life Cycle Process:** Estimate 0 seconds based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Sheets in Record (As-Built) Drawings: The average number of drawing sheets in As-Built Drawings.

- Current Life Cycle Process: Estimate 1048 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate

Avg. Time Spent Reviewing Record (As-Built) Drawings: The average time spent by Owner in reviewing the Record (As-Built) Drawings.

- Current Life Cycle Process: Estimate 30 seconds per sheet based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Number of Sheets in Final Approved Shop Drawings: The average number of drawing sheets in As-Built Drawings.

- Current Life Cycle Process: Estimate 2 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Reviewing Final Approved Shop Drawings: The average time spent by Owner in reviewing the Final Approved Drawings.

- Current Life Cycle Process: Estimate 30 seconds per sheet based on project analyzed.
- **Expected Life Cycle Process:** Estimate 0 seconds per sheet based on the reduction factor times the Current Life Cycle Process estimate.

250.08 File Turnover Package

Avg. Time Spent Filing Operations & Maintenance Manuals: The average time spent by Oymen in filing the Operations and Maintenance Manual

age time spent by Owner in filing the Operations and Maintenance Manual.

- Current Life Cycle Process: Estimate 5 minutes per document based on project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time Spent Filing Commissioning Report: The average time spent Owner in filing the Commissioning Report.

- *Current Life Cycle Process:* Estimate 5 minutes.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Time Spent Filing Record Specifications: The average time spent by Owner in filing the Record Specifications.

- Current Life Cycle Process: Estimate 5 minutes per document based on project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Sheets in Record (As-Built) Drawings: The average number of drawing sheets in As-Built Drawings.

- Current Life Cycle Process: Estimate 1048 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Filing Record (As-Built) Drawings: The average time spent by Owner in filing the Record (As-Built) Drawings.

- Current Life Cycle Process: Estimate 6 seconds per sheet based on project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Avg. Number of Sheets in Final Approved Shop Drawings: The average number of drawing sheets in As-Built Drawings.

- *Current Life Cycle Process:* Estimate 2 sheets based on project analyzed.
- Expected Life Cycle Process: Same as the Current Life Cycle Process estimate.

Avg. Time Spent Filing Final Approved Shop Drawings: The average time spent by Owner in filing the Final Approved Drawings.

- Current Life Cycle Process: Estimate 6 seconds per sheet based on project analyzed.
- Expected Life Cycle Process: Estimate 0 minutes based on the reduction factor times the Current Life Cycle Process estimate.

Appendix F: Assumptions for Short Form and the Program Analysis Form of the COBie Calculator

These are the assumptions used for the Short Form calculations.

Pre-Design Variables

Avg. Number of Pages in Space Program: Owners Space Program that documents spatial requirements covers 3 space types per letter sized page

Avg. Number of Pages in Product Program: Owners Product Program that documents equipment specifications and performance covers 3 product types per letter sized page

Submittal Process Variables

Average Number of Submittal Items in a Product Submittal Package:

The average number of submittal Items related to product per submittal package assumes 3 items per package

Facility Criteria

Avg. Inhouse Reproduction Time: Average time spent in printing and making copies of letter-sized pages. Small format printer produces 25 letter-sized pages per min

Discipline Specification

Avg. Inhouse Reproduction Time: Average time spent in printing and making copies of letter-sized pages. Small format printer produces 25 letter-sized pages per min

Feasibility Study

Avg. Inhouse Reproduction Time: Average time spent in printing and making copies of letter-sized pages. Small format printer produces 25 letter-sized pages per min

Project Definition

Avg. Inhouse Reproduction Time: Average time spent in printing and making copies of letter-sized pages. Small format printer produces 25 letter-sized pages per min

Space Program

Avg. Time for Owners Rep to Validate Space Program: Owners Rep spends 2 mins per space type validating spatial requirements in Space Program provided by Planner against Owner standards

Avg. Time Spent Searching for Space Program Criteria: Architect / Planner spends an estimate of 15 mins per space type searching for Spatial requirements

Avg. Time Spent Reformatting Space Program Criteria into Room Data Sheets: Architect / Planner spends an estimate of 5 mins per space type in evaluating information in Project Definition and identifying and creating a detailed spatial program in a usable format.

Product Program

Avg. Time for Owners Rep to Validate Product Program: Owners Rep spends 3 mins validating each Product Type in Product Program provided by Planner against Owner standards

Avg. Time Spent Searching for Product Program Criteria: Architect / Planner spends an estimate of 5 mins searching for Product Program Criteria

Estimating Process Variables

Avg QTO Time for Equipment Components: Architect spends an estimate of 5 mins per plan performing quantity take-off of equipment shown on plan drawings.

Avg QTO Time for Spaces in building: Architect spends an estimate of 9 mins per plan performing quantity take-off of spaces shown on plan drawings.

Design Early

Avg. Number of Sheets in Design Early Drawings: Estimated number of Design Early drawings.

Avg. Time Spent Evaluating Design Early Drawings against Design Requirements - Space and Product Type: Architect spends 9 mins per space or product type validating Design Early documentation against space and equipment requirements before submission to Owners Rep

Avg. Time spent making corrections due to non-conformance with Space or Product Program: Architect spends 5 mins per correction related to space or product type in Design Early Drawings, due to non-conformance with Space or Product Program. Also assume 30% of space and product types would require corrections.

Avg. Time to Review Design Early Drawings for conformance to Space and Product Program: Owners Rep spends 15mins per sheet reviewing Design Early documentation with 33% (4mins/sheet) of that time related to checking for conformance to Space and Product Program

Avg. Inhouse Reproduction Time: Small format printer produces 25 letter-sized pages per min while Large Format printer produces 6 sheets per min.

Avg. Time Spent Reformatting Space Program: Architect spends an estimate of 10 mins per space type documenting spatial requirements in a usable format

Avg. Time Spent Reformatting Product Program: Architect spends an estimate of 15 mins per product type documenting product type requirements in a usable format

Design Schematic

Avg. Number of Sheets in Design Schematic Drawings: Estimated number of Design Schematic (Design Development) drawings

Avg. Number of Plan Drawings in Design Schematic Drawings: Estimated number of Plan Drawings in Design Schematic (Design Development) Drawings

Avg. Time Spent Evaluating Design Schematic Drawings against Design Requirements - Space and Equipment: Architect spends 24 mins per space or product type validating Design Early documentation against space and equipment requirements before submission to Owners Rep

Avg. Time spent making corrections due to non-conformance with Space or Product Program: Architect spends 5 mins per correction related to space or product type in Design Schematic Drawings, due to non-conformance with Space or Product Program. Also assume 45% of space and product types would require corrections.

Avg. Time to Review Design Schematic Drawings for conformance to Space and Product Program: Owners Rep spends 15mins per sheet reviewing Design Early documentation with 33% (4mins/sheet) of that time related to checking for conformance to Space and Product Program

Avg. Inhouse Reproduction Time: Small format printer produces 25 letter sized pages per min while Large Format printer produces 6 sheets per min.

Avg. Time Spent Developing Equipment (product) Type Template: Architect spends an estimate of 15 mins per product in developing outline specifications for equipment types required for the project

Design Coordinated

Avg. Number of Sheets in Design Coordinated Drawings: Estimated number of Design Coordinated drawings

Avg. Number of Plan Drawings in Design Coordinated Drawings: Estimated number of Plan Drawings in Design Coordinated Drawings

Avg. Time Spent Evaluating Design Coordinated Drawings against Design Requirements - Space and Equipment: Architect spends 27 mins per space or product type validating Design Early documentation against space and equipment requirements before submission to Owners Rep

Avg. Time Spent making Corrections due to Non-Conformance with Space Program: Architect spends 5 mins per correction related to space or product type in Design Coordinated Drawings, due to non-conformance with Space or Product Program. Also assume 25% of space and product types would require corrections.

Avg. Time to Review Design Coordinated Drawings for conformance to Space and Product Program: Owners Rep spends 15mins per sheet reviewing Design Early documentation with 33% (4mins/sheet) of that time related to checking for conformance to Space and Product Program

Avg. Inhouse Reproduction Time: Small format printer produces 25 letter-sized pages per min while Large Format printer produces 6 sheets per min.

Avg. Time Spent Developing Detailed Equipment (products) Type Template: Architect spends an estimate of 2 hours per product type in writing the equipment specifications.

Avg. Time Searching for Product Literature for Candidates: Architect spends an estimate of 1 hour per product type in searching for 3 products that meet the specifications.

Avg. Percent of Errors in Product Type Candidate: Estimate 15% of products identified do not meet the specifications.

Design Final

Avg. Number of Sheets in Design Final Drawings: Estimated number of Design Final drawings.

Avg. Number of Plan Drawings in Design Final Drawings: Estimated number of Plan Drawings in Design Final Drawings

Avg. Time Spent Evaluating Design Final Drawings against Design Requirements - Space and Equipment: Architect spends 25 mins per space or product type validating Design Early documentation against space and equipment requirements before submission to Owners Rep

Avg. Time Spent making Corrections due to Non-Conformance with Space or Product Program: Architect spends 5 mins per correction related to space or product type in Design Final Drawings, due to non-conformance with Space or Product Program. Also assume 10% of space and product types would require corrections.

Avg. Inhouse Reproduction Time: Small format printer produces 25 letter sized pages per min while Large Format printer produces 6 sheets per min.

Avg. Time Spent Developing Detailed Equipment (products) Type Candidate: Architect spends an estimate of 1 hour per product preparing a detailed specifications list based on product types

Request for Proposal

Avg. Inhouse Reproduction Time: Small format printer produces 25 letter sized pages per min while Large Format printer produces 6 sheets per min.

Submittal Package

Avg. Inhouse Reproduction Time: Small format printer produces 25 letter-sized pages per min while Large Format printer produces 6 sheets per min.

Average Time Spent Organizing Equipment (product) Type information: Contractor Asst. Project Manager spends an estimate of 10 mins per product in producing submittal packages from product data submitted by subcontractors.

Average Time Spent Evaluating Equipment (product) Type Submittal Items against Contract Documents: Contractor spends an estimate of 30mins evaluating submittal items

Submittal Process Variables

Avg. Number of Submittal Pages in a Product Submittal Item: Estimate 18 letter-sized pages per submittal item

Avg. Number of Submittal Sheets in a Product Submittal Item: Estimate 2 sheets per submittal item

Submittal Issue

Avg. Time Spent Evaluating Product Type Submittal Items against Contract Documents: Architect spends an estimate of 1 hour per product type in evaluating each product type submittal against contract documents

Avg. Time Spent Revising one Product Type Submittal Item: Contractor spends an estimate of 30 mins revising each Submittal Item to meet contract requirements and resubmit.

Turnover Package

Avg. Time Spent Searching and Assembling Record (As-Built) Drawings (hours / sheet): Contractor spends an estimate of 30 secs per sheet compiling Record (As-Built) Drawings

Avg. Time Spent Searching and Assembling Final Approved Shop Drawings (hours / sheet): Contractor spends an estimate of 30 secs per sheet compiling Final Approved Drawings

Avg. Time Spent Reviewing Operations & Maintenance Manuals (hours/page): Owner spends an estimate of 6 seconds per page in reviewing Operations & Maintenance Manuals

Avg. Time Spent Reviewing Commissioning Report (hours / page): Owner spends an estimate of 30 seconds per page in reviewing Commissioning Report

Avg. Time Spent Reviewing Record Specifications (hours / page):Owner spends an estimate of 6 seconds per page in reviewing Record Specifications

Avg. Time Spent Reviewing Record (As-Built) Drawings (hours/sheet): Owner spends an estimate of 30 seconds per sheet in reviewing Record (As-Built) Drawings

Avg. Time Spent Reviewing Final Approved Shop Drawings (hours / sheet): Owner spends an estimate of 30 seconds per sheet in reviewing Final Approved Shop Drawings

Avg. Time Spent Filing Record (As-Built) Drawings (hours / sheet): Owner spends an estimate of 6 seconds per sheet in Filing Record (As-Built) Drawings

Avg. Time Spent Filing Final Approved Shop Drawings (hours / sheet): Owner spends an estimate of 6 seconds per sheet in Filing Final Approved Shop Drawings

Appendix G: COBie Calculator Template

Introduction Tab

COBie Calculator

Purpose:

This research will identify the potential savings/cost for a project team if information is echanged using a COBie-based approach over the traditional "Paper-Based" approach.

Project Phase Color Coding:

Criteria	
Project Definition	
Requirement	
Bidding	
Design	
Construction	

Assumptions Tab

Assumptions were made when developing the COBie Calculator. These assumptions should be modified based on your project variables in order to calculate the potential savings.

Information Attributes

LEGEND				
Color	Description	Allowed User Actions		
	user defined information unique to this worksheet	change on inputs worksheet in process specific variables section		
	common user information, listed on assumptions worksheet	change on inputs worksheet		
	calculated information	do not change this cell		

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Current Assumptions Tab

Inputs

Owner Project / Program Variables	Value	Unit	Definitions	Process
Avg. Number of Pages in Facility Criteria	0	pages	Estimated number of pages in Owners initial analysis of Project need and Scope.	10
Avg. Number of Pages in Discipline Specification	0	pages	Estimated number of pages in Equipment performance requirements during planning	20
Avg. Number of Pages in Project Definition	0	pages	Estimated number of pages in Project Definition document. The Project Definition defines the project scope, budget requirements, site details, economic analysis and facility planning data	40,70,80
Avg. Number of Pages in Front Matter	0	pages	Estimated number of pages that precede the technical content of the RFP for Design Services and Construction Services.	70, 120
Project Variables				
Number of Equipment (product) Types (Types / project)	0	types/proje ct	Number of different equipment types that will be installed.	60,80,90,100,11 0,180,190, 250
Number of Tagged Components (components / project)	0	compo- nents/ pro- ject	Total number of pieces of equipment that will have asset tags and will be managed by the owner	210
Number of Space Types per Building	0	space types/ building	Average number of space types found in building.	50,80

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Time to Log (hours / transmittal)	0	hours/ transmittal	Average Time spent logging documents In and Out	30,50,60,70,80, 90,100,110,120, 130,150,180,19 0,210,230,250
Pre-Design Variables				
Avg. Number of Options	0	count	Average number of options created per project	30
Avg. Pre-Design Submittal Sets Reqd. (sets / submittal)	0	sets/ sub- mittal	Average number of pre-design drawing sets required for each submittal.	30,50,60,70
Avg. Number of Sheets per Option	0	pages	Average number of drawings per option.	30
Avg. Number of Letter-Sized Pages in Design Narrative per Option	0	pages	Average number of pages in narrative for each option.	30
Avg. Number of Pages in Space Program	0	pages	Typical number of pages in Space Program.	50,70,80
Avg. Number of Pages in Product Program	0	pages	Typical number of pages in Product Program that documents Owners equipment specifications and performance	60,70,80
Design Variables				
Number of Design Submittal Sets Reqd. (sets / submittal)	0	sets / sub- mittal	Number of Design Phase drawing sets required	80,90,100,110
Avg. Number of Sheets in Design Early Drawings	0	drawings	Average number of Design Early or (Schematic Design) drawings for other disciplines	80
Avg. Number of Letter-Sized Pages in Design Early Narrative	0	pages	Average number of Letter-Sized Pages	80
Avg. Number of Sheets in Design Schematic Drawings	0	drawings	Average number of Design Schematic (Design Development) drawings	90

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Avg. Number of Submittal Items in a Submittal Package for each Equipment (product) Type (submittal items/submittal package)	0	submittal items / submittal package	Average number of product Items per submittal package	180,190
Avg. Number of Submittal Pages in a Submittal Item (pages/submittal item)	0	pag- es/submitta I item	Average number of letter-sized pages per submittal item	180,190
Avg. Number of Submittal Sheets in a Submittal Item (sheets/submittal item)	0	sheets/sub mittal item	Average number of drawings per submittal item	180,190

Organizational Variables

Owner Administrative Rate (\$ / hour)	-	\$ / hour	Rate for activities that cover Handling of documents	10,20,30,40,250
Owners Rep. Rate (\$ / hour)	-	\$ / hour	Rate for activities that include Validating of documents	50,60,80,90,100
Owners Rep. Administrative Rate (\$ / hour)	-	\$ / hour	Rate for activities that cover Handling of documents	50,60,70,80,90, 100,110,120,13 0,150,180
Planner Rate (\$ / hour)	-	\$ / hour	Rate for professional assisting owner in Pre-design activities.	50,60
Planner Administrative Rate (\$ / hour)	-	\$ / hour	Rate for activities that cover Handling of documents	30,50,60
Licensed Professional Architect Rate (\$ / hour)	-	\$ / hour	Rate including Professional Services, Overhead and Profit	80,90,100,110,1 90,230

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Architect Drafter Rate (\$ / hour)	-	\$ / hour	Rate including Professional Services, Overhead and Profit	70,80,90,100,11 0,130,150,180,1 90,210,230
Architect Administrative Rate (\$ / hour)	-	\$ / hour	Rate for activities that cover Handling of documents	, ,
Construction Project Manager Rate (\$ / hour)	-	\$ / hour	Rate including Professional Services, Overhead and Profit	180,190,200,21 0,250
Assistant (Construction) Project Manager Rate (\$ / hour)	-	\$ / hour	Rate including Professional Services, Overhead and Profit	180,190,210,25 0
Contractor Administrative Rate (\$ / hour)	-	\$ / hour	Rate for activities that cover Handling of documents	130, 150, 180, 190, 210, 230, 250

\$ / hour

General Repro/Postal Delivery Cost

Specifier

Avg. Per Page Copy Cost (\$ / page)	-	\$ / sheet	-	10,20,30,40,50, 60,70,80,90,100
				,110,120,180,25
Avg. Per Sheet Copy Cost (\$ / sheet)	-	\$ / sheet	-	30,70,80,90,100
				,110,120,180,25 0

Process Specific Variables

Facility Criteria

Avg. Number of Sets Required (sets / submittal)	0	sets / sub- mittal	Average number of sets required
Avg. In-house Reproduction Time Per Set (hours/set)	0	hours/set	Average time spent in printing and making copies of Facility Criteria by Owner

Discipline Specification

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Avg. In-house Reproduction Time Per Set (hours/set)	0	hours/set	Average time spent in printing and making copies of Discipline Specification by Owner
Feasibility Study			
Avg. Number of Transmittals	0	Transmit- tals	Average number of times options / comments are exchanged between the Planner and Owner times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours/ submittal set	Average time spent in printing and making copies of feasibility study by Planner
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Trans- mittal	Average cost for delivering documents/comments sent between Planner and Owner
Avg. Time to Prepare Transmittal (hours / transmittal)	0.000	hours / transmittal	Average time spent in compiling documents for transmittal
Project Definition			
Avg. Number of Sets Required (sets / submittal)	0	sets	Average number of sets required
Avg. In-house Reproduction Time Per Set (hours/set)	0	hours/set	Average time spent in printing and making copies of Project Definition by Owner
Space Program			
Avg. Time Spent Recreating Space Program Criteria (hours/space)	0	hours / space	Average time spent by Planner recreating Space Program Criteria
Avg. Time Spent Reformatting Room Data Sheet (hours/space)	0	hours	Average time spent in evaluating information in Project Definition and identifying and creating a detailed spatial program
Avg. Time to Compare Space Program with Owner	0	hours	Average time spent by Owners Rep in validating
Standards (hours)			Space Program provided by planner

sets

Average number of sets required

Avg. Number of Sets Required (sets / submittal)

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Avg. Percentage of errors in Space Program	0	%	Average percentage of errors found by Owners Rep in Space Program
Avg. Time Spent Recreating Space Program (hours/space)	0	hours / space	Average time spent by Planner recreating Space Program
Avg. Number of Re-Submit Cycles	0	Cycles	Average number of times submitted documents are re-submitted
Avg. Number of Transmittals	0	Transmit- tals	Average number of times Space Program / Comments are sent between the Planner and Owners Rep times the number of recipients for each exchange.
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	0	\$ / Trans- mittal	Average cost for delivering documents/comments sent between Planner and Owners Rep
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmittal	Average time spent in compiling documents for transmittal
Product Program			
Avg. Time Spent Recreating Product Program Criteria (hours / product)	0	hours / product	Average time spent by Planner recreating Product Program Criteria
Avg Time to Compare Product Program with Owner Standards (hours)	0	hour	Average time spent by Owners Rep in validating Product Program provided by Planner
Avg. Percentage of errors in Product Program	0	%	Average percentage of errors found by Owners Rep in Product Program
Avg. Time Spent Recreating Product Program (hours/space)	0	hours / space	Average time spent by Planner recreating Product Program
Avg. Number of Re-Submit Cycles	0	Cycles	Average number of times submitted documents are re-submitted

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Avg. Number of Transmittals	0	Transmit- tals	Average number of times Product Program / Comments are sent between the Planner and Owners Rep times the number of recipients for each exchange.
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	0	\$ / Trans- mittal	Average cost for mailing documents/comments sent between Planner and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmittal	Average time spent in compiling documents for transmittal.
Request for Proposal			
Avg. Number of Letter Sized Pages in RFP (pages / proposal)	0	pages / proposal	Average number of Letter-Sized Pages
Avg. Number of Drawing Sheets in Proposal (sheets / proposal)	0	sheets / proposal	Average number of Drawings
Number of RFP copies Reqd. (sets / submittal)	0	sets / sub- mittal	Number of RFP copies required
Avg. Number of Transmittals - Owners Rep documents to Bidders	0	Transmit- tals	Average number of times Proposal is sent from the Owners Rep to the Bidders times the number of recipients for each exchange.
Avg. Number of Transmittals - Architect to Owner	0	Transmit- tals	Average number of times Proposal is sent from the Architect to the Owners Rep times the number of recipients for each exchange.
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submittal set	Average time spent in printing and making copies of Proposal by Architect
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep documents to Bidders	0	\$ / Trans- mittal	Average cost for mailing documents/comments sent between Owners Rep and Architect

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Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	0	\$ / Trans- mittal	Average cost for mailing proposal between Architect and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal) - Owners Rep	0	hours / transmittal	Average time spent in compiling documents for transmittal / submission
Avg. Time to Prepare Transmittal (hours / transmittal) - Architect	0	hours / transmittal	Average time spent in compiling documents for transmittal / submission
Design Early			
Avg. Time Spent Reformatting Space Program Requirements(hours / space type)	0.00	hours / space type	Average time spent by Architect in reformatting spatial requirements
Avg. Time Spent Reformatting Equipment Type (hours /product)	0.00	hours / product	Average Time spent by Architect reformatting equipment types
Avg. Time Spent Evaluating Design Early Drawings against Design Requirements - Space and Equipment	0.00	hours	Average time spent by Architect in validating Design Early drawings before submission to Owners Rep
Avg. Time spent making corrections due to non- conformance with Space or Product Program	0.00	hours	Average time spent by Architect making corrections based on internal evaluation and feedback from Owners Rep.
Avg Time to Compare Design Early Documents with Owner Standards	0.00	hours	Average time spent by Owners Rep in validating Design Early documents
Avg. Number of Re-Submit Cycles	0.00	Cycles	Average number of times submitted documents are re-submitted
Percentage of Time Spent by Licensed Professional Architect	0.00	%	Percentage of time spent by Licensed Architect reformatting Space Program, Equipment Type and Project Definition
Percentage of Time Spent by Architect Drafter	0.00	%	Percentage of time spent by Architect Drafter reformatting Space Program, Equipment Type and Project Definition

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Avg. Number of Transmittals	0.00	Transmit- tals	Average number of times drawings, narratives and comments are sent and received between the Architect / Planner and Owner times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0.00	hours / submittal set	Average time spent in printing and making copies of drawings and narratives by Architect / Planner
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep to Architect	0.00	\$ / Trans- mittal	Average cost for mailing documents/comments sent between Owners Rep and Architect
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	0.00	\$ / Trans- mittal	Average cost for mailing documents/comments between Architect and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0.00	hours / transmittal	Average time spent compiling copies of drawings, narratives and comments for transmittal by Architect and Owners Rep.
Design Schematic			
Avg. Number of Plan Drawings in Design Schematic Drawings	0	plans / drawing set	Average number of Plan Drawings
Avg. Time Spent Developing Equipment (product) Type Template (hours / product type)	0	hours / product type	Time spent by Architect in developing specifications for equipment types required for the project
Avg. Time Spent Evaluating Design Schematic Drawings against Design Requirements - Space and Equipment	0	hours	Average time spent by Architect in validating Design Schematic drawings before submission to Owners Rep
Avg. Time spent making corrections due to non- conformance with Space or Product Program	0	hours	Average time spent by Architect making corrections based on internal evaluation and feedback from Owners Rep.

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Avg Time to Compare Design Schematic Documents with Owner Standards	0	hours	Average time spent by Owners Rep in validating Design Schematic documents
Avg. Number of Re-Submit Cycles	0	Cycles	Average number of times submitted documents are re-submitted
Percentage of Time Spent by Licensed Professional Architect	0	%	Percentage of time spent by Licensed Architect to take off all equipment pieces and to calculate areas
Percentage of Time Spent by Architect Drafter	0	%	Percentage of time spent by Architect Drafter to take off all equipment pieces and to calculate areas
Avg. Number of Transmittals	0	Transmit- tals	Average number of times schematic drawings, narratives, specifications and comments are sent and received between the Architect / Planner and Owner times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours/subm ittal set	Average time spent in printing and making copies of drawings, narratives and specifications by Architect / Planner
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep to Architect	0	\$ / Trans- mittal	Average cost for mailing documents/comments sent between Owners Rep and Architect
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	0	\$ / Trans- mittal	Average cost for mailing documents/comments between Architect and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmittal	Average time spent compiling copies of schematic drawings, narratives, specifications and comments for transmittal by Architect and Owners Rep.

Design Coordinated

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Avg. Number of Plan Drawings in Design Coordinate Drawings	0	plans / drawing set	Average number of Plan Drawings
Avg. Time Spent Developing Detailed Equipment (products) Type Template (hours / product)	0	hours / product	Time spent by Architect in preparing a detailed specifications list based on equipment types
Avg. Time Searching for Product Literature for Candidates (Hours/product)	0	hours / product	Average Time spent by Architect in searching for product data
Avg. Time Spent Evaluating Design Coordinated Drawings against Design Requirements - Space and Equipment	0	hours	Average time spent by Architect in validating Design Coordinated drawings before submission to Owners Rep
Avg. Time Spent making Corrections due to Non-Conformance with Space Program	0	hours	Average time spent by Architect making corrections based on internal evaluation and feedback from Owners Rep.
Avg. Percent of Errors in Product Type Candidate	0	%	Percentage of errors in Product Type List
Avg Time to Compare Design Coordinated & Product Type Candidate Documents with Owner Standards	0	hours	Average time spent by Owners Rep in validating Design Coordinated documents
Avg. Number of Re-Submit Cycles	0	Cycles	Average number of times submitted documents are re-submitted
Percentage of Time Spent by Licensed Professional Architect	0	%	Percentage of time spent by Licensed Architect to take off all equipment pieces and to calculate areas
Percentage of Time Spent by Architect Drafter	0	%	Percentage of time spent by Architect Drafter to take off all equipment pieces and to calculate areas
Avg. Number of Transmittals	0	Transmit- tals	Average number of times coordinated drawings, narratives, specifications and comments are sent and received between the Architect and Owners Rep times the number of recipients for each exchange

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Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submittal set	Average time spent in printing and making copies of drawings, narratives and specifications by Architect
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep to Architect	0	\$ / Trans- mittal	Average cost for mailing documents/comments sent between Owners Rep and Architect
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	0	\$ / Trans- mittal	Average cost for mailing documents between Architect and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmittal	Average time spent compiling copies of coordinated drawings, narratives, specifications and comments for transmittal by Architect and Owners Rep
Design Final			
Avg. Number of Plan Drawings in Design Final Drawings	0	plans / drawing set	Average number of Plan Drawings
Avg. Time Spent Developing Detailed Equipment (products) Type Candidate (hours / product)	0	hours / product	Time spent by Architect in preparing a detailed specifications list based on equipment types
Avg. Time Spent Evaluating Design Final Drawings against Design Requirements - Space and Equipment	0	hours	Average time spent by Architect in validating Design Final drawings before submission to Owners Rep
Avg. Time Spent making Corrections due to Non- Conformance with Space or Product Program	0	hours	Average time spent by Architect making corrections based on internal evaluation and feedback from Owners Rep.
Percentage of Time Spent by Licensed Professional Architect	0	%	Percentage of time spent by Licensed Architect to take off all equipment pieces and to calculate areas
Percentage of Time Spent by Architect Drafter	0	%	Percentage of time spent by Architect Drafter to take off all equipment pieces and to calculate areas

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			Architect
Request for Proposal			
Avg. Number of Transmittals	0	Transmit- tals	Average number of times RFP Package is sent from Owners Rep to Contractor times the number of recipients for purpose of bidding.
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submittal set	Average time spent in printing and making copies of RFP Package by Owners Rep.
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	0	\$ / Trans- mittal	Average cost for mailing RFP by Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmittal	Time spent compiling documents, drawings or specifications for transmittal by Owners Rep.
Avg. Number of Request for Proposal Submittal Sets Reqd.	0	submittal sets	Average number of RFP sets required for submission

Transmit-

tals

hours /

set

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hours /

transmittal

0

0

0

submittal

\$ / Trans-

\$ / Trans-

tect / Planner

tect and Owners Rep.

Average number of times final drawings, narra-

tives, specifications and comments are sent and received between the Architect and Owners Rep times the number of recipients for each exchange.

Average time spent in printing and making copies of drawings, narratives and specifications by Archi-

Average cost for mailing documents/comments

Average cost for mailing proposal between Archi-

Average time spent compiling copies of final draw-

ings, narratives, specifications for transmittal by

sent between Owners Rep and Architect

Avg. Number of Transmittals

(hours/submittal set)

Owners Rep to Architect

chitect to Owners Rep

Avg. In-house Reproduction Time Per Submittal Set

Avg. Mailing Cost per Transmittal (\$ / Transmittal) -

Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Ar-

Avg. Time to Prepare Transmittal (hours / transmittal)

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Inquiry Issue

inqui y ioodo			
Avg. Number of Transmittals	0	Transmit- tals	Average number of times Inquiry Issues and responses are sent and received between Owners Rep, Architect and Contractor times the number of recipients for each exchange
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	0	\$ / Trans- mittal	Average cost for mailing documents/comments sent between Owners Rep, Architect, and Contractor
Avg. Time to Prepare Transmittals for Inquiry Issues (hours / transmittal) - Contractor / Architect	0	hours / transmittal	Time spent compiling documents, drawings or specifications for transmittal by Architect and Contractor
Avg. Time to Prepare Transmittals for Inquiry Issues (hours / transmittal) - Owners Rep	0	hours / transmittal	Time spent compiling documents, drawings or specifications for transmittal by Owners Rep.
Pre-Construction Plan			

Inquiry Issue (RFI)

inquiry issue (Kri)			
Avg. Number of RFIs	0	Transmit- tals	Average number of times Inquiry Issues (RFI) and responses are sent and received between Owners Rep, Architect and Contractor times the number of recipients for each exchange
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	0	\$ / Trans- mittal	Average cost for mailing documents/comments sent between Owners Rep, Architect, and Contractor
Avg. Time to Prepare Transmittals for Inquiry Issues (RFI) (hours / transmittal) - Contractor / Architect	0	hours / transmittal	Average Time spent compiling Inquiry Issues (RFI) for transmittal by Architect and Contractor

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Avg. Time to Prepare Transmittals for Inquiry Issues (RFI) (hours / transmittal) - <i>Owner</i>	0.00	hours / transmittal	Average Time spent compiling Inquiry Issues (RFI) for transmittal by Owners Rep
Product Type Selection			
Suntain Lavavit			
System Layout			
Submittal Package			
Average Time Spent Organizing Equipment (product) Type information (hours / submittal item)	0.00	hours / submittal item	Average Time spent by asst. project manager in producing submittal information by organizing equipment type information
Average Time Spent Evaluating Equipment (product) Type Submittal Items against Contract Documents (hours / submittal item)	0.00	hours / submittal item	Average Time spent evaluating submittal items
Avg. Time to Sign each Page (hours / page)	0.00	hours/page	Average time required by Contractor to sign pages of Submittal Package
Avg. Time to Stamp each Sheet (hours / sheet)	0.00	hours/sheet	Average time required by Contractor to stamp sheets of Submittal Package
Percentage of Submittals Items rejected	0.00	%	Percentage of items rejected
Percentage of Time Spent by Construction Project Manager	0.00	%	Percentage of time spent by Construction Project Manager in validating Submittal Information
Percentage of Time Spent by Assistant (Construction) Project Manager	0.00	%	Percentage of time spent by Assistant Construc- tion Project Manager in validating Submittal Infor- mation
Avg. Number of Transmittals	0.00	Transmit- tals	Average number of times Submittal Packages are sent and received between Owners Rep, Architect and Contractor times the number of recipients for each exchange

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Avg. Time to Prepare Transmittal (hours / transmittal)	0.00	hours / transmittal	Average time spent compiling Submittal Package for transmittal by Architect / Contractor
Submittal Issue			
Avg. Time Spent Evaluating Product Type Submittal Items against Contract Documents (hours / product type submittal item)	0	hours / submittal item	Average Time spent by Architect in evaluating submittal package of equipment types
Avg. Time Spent Revising one Product Submittal Item (hours / product)	0	hours / product	Average Time spent by Contractor recreating Submittal Items
Percentage of Product Submittals reviewed by Licensed Architect	0	%	Percentage of submittals reviewed by Architect
Percentage of Product Submittals rejected on first review	0	%	Percentage of submittals rejected upon review
Percentage of Product Submittals rejected on second review	0	%	Percentage of submittals rejected upon review
Percentage of Product Submittals rejected on third review	0	%	Percentage of submittals rejected upon review
Avg. Time Spent Transferring Comments per Page	0	hours / page	Time spent by Architect in marking up submittal with comments
Avg. Time Spent Transferring Comments per Sheet	0	hours / sheet	Time spent by Architect in marking up submittal with comments
Percentage of Time Spent by Construction Project Manager	0	%	Percentage of time spent by Construction Project Manager in recreating Submittal Package
Percentage of Time Spent by Assistant (Construction) Project Manager	0	%	Percentage of time spent by Assistant Construction Project Manager in recreating Submittal Package

0.00

0.00

hours / submittal set

\$ / Transmittal

Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)

Average Mailing Costs per Transmittal (\$)

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Average time spent in printing and making copies of Submittal Package by Contractor

Average cost for Mailing documents/transmittals sent between Owners Rep and Contractor

Avg. Number of Transmittals	0	Transmit- tals	Average number of times Submittal Packages (pages and sheets) are sent and received between Architect and Contractor times the number of recipients for each exchange
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmittal	Average time spent compiling Submittal Package for transmittal by Architect
Avg. Mailing Cost per Transmittal	0	\$ / Trans- mittal	Average cost for Mailing documents/transmittals between Architect / Planner and Contractor
Purchase Order			
Product Installation			
Avg. Time Spent Re-formatting Product Installation Report in Office (hours/ component)	0.00	hours / component	Average time spent by Contractor in the office re- formatting report
Avg. Number of Transmittals (Transmittals)	0	Transmit- tals	Average number of times Product Installation Reports are sent and received between Contractor and Architect / Owner times the number of recipients for each exchange
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Trans- mittal	Average cost for mailing Product Installation Report by Contractor
Avg. Time to Prepare a Transmittal (hours/transmittal)	0.000	hours / transmittal	Average time spent compiling Product Installation for transmittal by Assistant Construction Manager
Start-Up			
Product Inspection			
Avg. Field Time Spent Documenting Report per Site Visit (hours / visit)	0	hours / visit	Average time spent in the field documenting data during site visits.

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0	visits / month	Average number of times site is visited in a month
0	months	Average construction duration of a project
0	hours / day	Total time spent in the office on a daily basis
0	%	Average percentage of time spent in the office documenting data recorded from the field.
0	Transmit- tals	Average number of times Inspection Reports are sent and received between Architect and Contractor times the number of recipients for each exchange
0	\$ / Trans- mittal	Average cost for mailing Inspection Reports by Architect
0	hours / transmittal	Average time spent compiling Inspection Report for transmittal by Architect
	0 0 0 0	month 0 months 0 hours / day 0 % 0 Transmittals 0 \$ / Transmittal 0 hours /

Punch list Issue

Turnover Package

ramovor raonago			
Avg. Time Spent Searching and Assembling Operations & Maintenance Manuals (hours / document)	0	hours / document	Time spent compiling O&M Manual
Avg. Time Spent Searching and Assembling Commissioning Report (hours / document)	0	hours / document	Time spent compiling Commissioning Report
Avg. Time Spent Searching and Assembling Record Specifications (hours / document)	0	hours / document	Time spent compiling Record Specifications
Avg. Time Spent Searching and Assembling Record (As-Built) Drawings (hours / sheet)	0	hours / sheet	Time spent compiling Record (As-Built) Drawings

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Avg. Time Spent Searching and Assembling Final Approved Shop Drawings (hours / sheet)	0	hours / sheet	Time spent compiling Final Approved Shop Drawings
Avg. Number of Pages in Operations & Maintenance Manuals (pages / product)	0	pages / component	Number of Pages in Operations & Maintenance Manuals
Avg. Number of Pages in Commissioning Report	0	pages / component	Number of Pages in Commissioning Report
Avg. Number of Components & Systems to be Commissioned	0	compo- nents	Number of Components to be commissioned
Avg. Number of Pages in Record Specifications	0	pages	Number of Pages in Record Specifications
Avg. Number of Sheets in Record (As-Built) Drawings	0	sheets	Number of Sheets in Record (As-Built) Drawings
Avg. Number of Sheets in Final Approved Shop Drawings	0	sheets	Number of Sheets in Final Approved Shop Drawings
Avg. Time Spent Reviewing Operations & Maintenance Manuals (hours/page)	0	hours / page	Time Spent Reviewing Operations & Maintenance Manuals
Avg. Time Spent Reviewing Commissioning Report (hours / page)	0	hours / page	Time Spent Reviewing Commissioning Report
Avg. Time Spent Reviewing Record Specifications (hours / page)	0	hours / page	Time Spent Reviewing Record Specifications
Avg. Time Spent Reviewing Record (As-Built) Drawings (hours/ sheet)	0	hours / sheet	Time Spent Reviewing Record (As-Built) Drawings
Avg. Time Spent Reviewing Final Approved Shop Drawings (hours / sheet)	0	hours / sheet	Time Spent Reviewing Final Approved Shop Drawings
Avg. Time Spent Filing Operations & Maintenance Manuals (hours/document)	0	hours / document	Time Spent Filing Operations & Maintenance Manuals
Avg. Time Spent Filing Commissioning Report (hours/document)	0	hours / document	Time Spent Filing Commissioning Report
Avg. Time Spent Filing Record Specifications (hours/document)	0	hours / document	Time Spent Filing Record Specifications

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Avg. Time Spent Filing Record (As-Built) Drawings (hours / sheet)	0	hours / sheet	Time Spent Filing Record (As-Built) Drawings
Avg. Time Spent Filing Final Approved Shop Drawings(hours / sheet)	0	hours / sheet	Time Spent Filing Final Approved Shop Drawings
Percentage of Time Spent by Construction Project Manager	0	%	Percentage of time spent by Construction Project Manager in compiling Turnover Package
Percentage of Time Spent by Assistant (Construction) Project Manager	0	%	Percentage of time spent by Assistant Construction Project Manager in compiling Turnover Package
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submittal set	Average time spent in printing and making copies of Turnover Package by Contractor
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	0	\$ / Trans- mittal	Average cost for mailing Turnover Package by Contractor
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmittal	Average time spent compiling Turnover Package for transmittal by Contractor

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Expected Assumptions Tab

NOTE: Red text indicates variables affected by the expected process.

Inputs

Owner Project / Program Variables	Current Value	Unit	Reduction Factor	Expected Outcome	Definitions	Process
Avg. Number of Pages in Facility Criteria	0	pages		0.00	Estimated number of pages in Owners initial analysis of Project need and Scope.	10
Avg. Number of Pages in Discipline Specification	0	pages		0.00	Estimated number of pages in Equipment performance requirements during planning	20
Avg. Number of Pages in Project Definition	0	pages		0.00	Estimated number of pages in Project Definition document. The Project Definition defines the project scope, budget requirements, site details, economic analysis and facility planning data	40,70,80
Avg. Number of Pages in Front Matter	0	pages		0.00	Estimated number of pages that precede the technical content of the RFP for Design Services and Construction Services.	70, 120

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Project Variables

Number of Equipment (product) Types (Types / project)	0	types / project		0.00	Number of different equipment types that will be installed.	60,80,90,100,110,180,190, 250
Number of Tagged Components (components / project)	0	components / project		0.00	Total number of pieces of equipment that will have asset tags and will be managed by the owner	210
Number of Space Types per Building	0	space types / building		0.00	Average number of space types found in building.	50,80
Time to Log (hours / transmittal)	0	hours / transmit- tal	100%	0.00	Average Time spent logging documents In and Out	30,50,60,70,80,90,100,110,1 20,130,150,180,190,210,230, 250
Pre-Design Variables						
Avg. Number of Options	0	count		0.00	Average number of options created per project	30
Avg. Pre-Design Submittal Sets Reqd. (sets / submittal)	0	sets / submittal	100%	0.00	Average number of pre-design drawing sets required for each submittal.	30,50,60,70
Avg. Number of Sheets per Option	0	pages		0.00	Average number of drawings per option.	30
Avg. Number of Letter-Sized Pages in Design Narrative per Option	0	pages		0.00	Average number of pages in narrative for each option.	30
Avg. Number of Pages in Space Program	0	pages		0.00	Typical number of pages in Space Program.	50,70,80

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0

pages

0.00

Typical number of

pages in Product Program that documents
Owners equipment

60,70,80

Avg. Number of Pages in Product Program

EXPECTED ASSUMPTIONS PAGE 3 OF 28

0.00

0.00

0.00

0.00

0.00

Average number of

pages in Design Coordinated narrative.

Average number of

pages in Design Coor-

dinated specifications.

Design Final drawings. Average number of

pages in Design Final

Average number of

pages in Design Final specifications.

narrative.

Average number of

100

100

110,120

110,120

110,120

Avg. Number of Letter Sized Pages in a Design Coor-

Avg. Number of Letter Sized Pages in a Design Coor-

Avg. Number of Sheets in Design Final Drawings

Avg. Number of Letter Sized 'Pages in Design Final

Avg. Number of Letter Sized Pages in Design Final

dinated Narrative

Narrative

Specification

dinated Specification

0

0

0

0

0

pages

pages

drawings

pages

pages

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(pages/submittal item)	U	item	0.00	letter-sized pages per submittal item	180,190
Avg. Number of Submittal Sheets in a Submittal Item (sheets/submittal item)	0	sheets/submittal item	0.00	Average number of drawings required	180,190
Organizational Variables					
Owner Administrative Rate (\$ / hour)	-	\$ / hour	-	Rate for activities that cover Handling of doc- uments	10,20,30,40,250
Owners Rep. Rate (\$ / hour)	-	\$ / hour	-	Rate for activities that include Validating of documents	50,60,80,90,100
Owners Rep. Administrative Rate (\$ / hour)	-	\$ / hour	-	Rate for activities that cover Handling of doc- uments	50,60,70,80,90,100,110,120, 130,150,180
Planner Rate (\$ / hour)	-	\$ / hour	-	Rate for professional assisting owner in Predesign activities.	50,60
Planner Administrative Rate (\$ / hour)	-	\$ / hour	-	Rate for activities that cover Handling of doc- uments	30,50,60
Licensed Professional Architect Rate (\$ / hour)	-	\$ / hour	-	Rate including Professional Services, Overhead and Profit	80,90,100,110,190,230
Specifier	-	\$ / hour	-	neau anu Fioni	
Architect Drafter Rate (\$ / hour)	-	\$ / hour	-	Rate including Professional Services, Overhead and Profit	70,80,90,100,110,130,150,18 0,190,210,230
Architect Administrative Rate (\$ / hour)	-	\$ / hour	-	Rate for activities that cover Handling of documents	

pages/submittal item

0

0.00

Average number of

180,190

Avg. Number of Submittal Pages in a Submittal Item (pages/submittal item)

EXPECTED ASSUMPTIONS PAGE 5 OF 28

-	\$ / hour		-	Rate including Professional Services, Overhead and Profit	180,190,200,210,250
-	\$ / hour		-	Rate including Professional Services, Overhead and Profit	180,190,210,250
-	\$ / hour		-	Rate for activities that cover Handling of doc- uments	130, 150, 180, 190, 210, 230, 250
-	\$ / sheet	100%	-	-	10,20,30,40,50,60,70,80,90,1 00,110,120,180,250
-	\$ / sheet	100%	-	-	30,70,80,90,100,110,120,180 ,250
	-	- \$ / hour - \$ / hour - \$ / sheet	- \$ / hour - \$ / sheet 100%	- \$ / hour \$ / hour \$ / sheet 100% -	sional Services, Overhead and Profit - \$ / hour - Rate including Professional Services, Overhead and Profit - \$ / hour - Rate for activities that cover Handling of documents - \$ / sheet 100%

Process Specific Variables

Facility Criteria			Reduction Factor	Expected Outcome	
Avg. Number of Sets Required (sets / submittal)	0	sets / submittal	100%	0.00	Average number of sets required
Avg. In-house Reproduction Time Per Set (hours/set)	0	hours/set	100%	0.00	Average time spent in printing and making copies of Facility Criteria by Owner

Discipline Specification

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Avg. Number of Sets Required (sets / submittal)	0	sets / submittal	100%	0.00	Average number of sets required
Avg. In-house Reproduction Time Per Set (hours/set)	0	hours/set	100%	0.00	Average time spent in printing and making copies of Discipline Specification by Owner
Feasibility Study					
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times options / comments are exchanged between the Planner and Owner times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submit- tal set	100%	0.00	Average time spent in printing and making copies of feasibility study by Planner
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%	0.00	Average cost for delivering documents/comments sent between Planner and Owner
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	Average time spent in compiling documents for transmittal
Project Definition					
Avg. Number of Sets Required (sets / submittal)	0	sets	100%	0.00	Average number of sets required
Avg. In-house Reproduction Time Per Set (hours/set)	0	hours/set	100%	0.00	Average time spent in printing and making copies of Project Definition by Owner

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Space Program

Avg. Time Spent Recreating Space Program Criteria (hours/space)	0	hours / space	100%	0.00	Average time spent by Planner recreating Space Program Criteria
Avg. Time Spent Reformatting Room Data Sheet (hours/space)	0.000	hours	100%	0.00	Average time spent in evaluating information in Project Definition and identifying and creating a detailed spatial program
Avg. Time to Compare Space Program with Owner Standards (hours)	0	hours	90%	0.00	Average time spent by Owners Rep in validat- ing Space Program provided by planner
Avg. Percentage of errors in Space Program	0%	%	100%	0.00	Average percentage of errors found by Owners Rep in Space Program
Avg. Time Spent Recreating Space Program (hours/space)	0	hours / space	100%	0.00	Average time spent by Planner recreating Space Program
Avg. Number of Re-Submit Cycles	0	Cycles	100%	0.00	Average number of times submitted documents are re-submitted
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times Space Program / Comments are sent between the Planner and Owners Rep times the number of recipients for each exchange.

EXPECTED ASSUMPTIONS PAGE 8 OF 28

Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%		Average cost for delivering documents/comments sent between Planner and Owners Rep
Avg. Time to Prepare Transmittal (hours / transmittal)	0.00	hours / transmit- tal	60%	0.00	Average time spent in compiling documents for transmittal
Product Program					
Avg. Time Spent Recreating Product Program Criteria (hours / product)	0	hours / product	100%	0.00	Average time spent by Planner recreating Product Program Criteria
Avg Time to Compare Product Program with Owner Standards (hours/product)	0	hour	90%	0.00	Average time spent by Owners Rep in validat- ing Product Program provided by Planner
Avg. Percentage of errors in Product Program	0%	%	100%	0.00	Average percentage of errors found by Own- ers Rep in Product Program
Avg. Time Spent Recreating Product Program (hours/product)	0.000	hours / product	100%	0.00	Average time spent by Planner recreating Product Program
Avg. Number of Re-Submit Cycles	0	Cycles	100%	0.00	Average number of times submitted documents are re-submitted
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times Product Program / Comments are sent between the Planner and Owners Rep times the number of recipients for each exchange.

EXPECTED ASSUMPTIONS PAGE 9 OF 28

Avg. Mailing Cost per Transmittal (\$ / Transmittal) Avg. Time to Prepare Transmittal (hours / transmittal)	0.00	\$ / Transmittal hours / transmit- tal	60%	0.00	Average cost for mailing documents/comments sent between Planner and Owners Rep. Average time spent in compiling documents for transmittal.
Request for Proposal					ioi transmittai.
Avg. Number of Letter Sized Pages in RFP (pages / proposal)	0	pages / pro- posal		0.00	Average number of Letter-Sized Pages
Avg. Number of Drawing Sheets in Proposal (sheets / proposal)	0	sheets / pro- posal		0.00	Average number of Drawings
Number of RFP copies Reqd. (sets / submittal)	0	sets / submittal	100%	0.00	Number of RFP copies required
Avg. Number of Transmittals - Owners Rep documents to Bidders	0	Transmittals	-	0.00	Average number of times Proposal is sent from the Owners Rep to the Bidders times the number of recipients for each exchange.
Avg. Number of Transmittals - Architect to Owner	0	Transmittals	-	0.00	Average number of times Proposal is sent from the Architect to the Owners Rep times the number of recipients for each exchange.
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submit- tal set	100%	0.00	Average time spent in printing and making copies of Proposal by Architect

EXPECTED ASSUMPTIONS PAGE 10 OF 28

Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep documents to Bidders	-	\$ / Transmittal	100%	•	Average cost for mailing proposal between Architect and Owners Rep.
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	-	\$ / Transmittal	100%	-	Average cost for mailing proposal between Architect and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal) - Owners Rep	0	hours / transmit- tal	60%	0.00	Average time spent in compiling documents for transmittal / submission
Avg. Time to Prepare Transmittal (hours / transmittal) - Architect	0	hours / transmit- tal	60%	0.00	Average time spent in compiling documents for transmittal / submission
Design Early					
Avg. Time Spent Reformatting Space Program Requirements(hours / space type)	0.00	hours / space type	100%	0.00	Average time spent by Architect in reformat- ting spatial require- ments
Avg. Time Spent Reformatting Equipment Type (hours /product)	0	hours / product	100%	0.00	Average Time spent by Architect reformatting equipment types
Avg. Time Spent Evaluating Design Early Drawings against Design Requirements - Space and Equipment	0	hours	90%	0.00	Average time spent by Architect in validating Design Early drawings before submission to Owners Rep
Avg. Time spent making corrections due to non- conformance with Space or Product Program	0	hours	100%	0.00	Average time spent by Architect making corrections based on internal evaluation and feedback from Owners Rep.

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Avg Time to Compare Design Early Documents with Owner Standards	0	hours	90%	0.00	Average time spent by Owners Rep in validat- ing Design Early doc- uments
Avg. Number of Re-Submit Cycles	0	Cycles	100%	0.00	Average number of times submitted documents are re-submitted
Percentage of Time Spent by Licensed Professional Architect	0%	%	-	0%	Percentage of time spent by Licensed Architect reformatting Space Program, Equipment Type and Project Definition
Percentage of Time Spent by Architect Drafter	0%	%	-	0%	Percentage of time spent by Architect Drafter reformatting Space Program, Equipment Type and Project Definition
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times drawings, narratives and comments are sent and received between the Architect / Planner and Owner times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submit- tal set	100%	0.00	Average time spent in printing and making copies of drawings and narratives by Architect / Planner
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep to Architect	-	\$ / Transmittal	100%	•	Average cost for mailing documents/comments sent between Owners Repand Architect

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Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	-	\$ / Transmittal	100%	-	Average cost for mailing documents/comments between Architect and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	Average time spent compiling copies of drawings, narratives and comments for transmittal by Architect and Owners Rep.
Design Schematic					
Avg. Number of Plan Drawings in Design Schematic Drawings	0	plans / drawing set	-	0.00	Average number of Plan Drawings
Avg. Time Spent Developing Equipment (product) Type Template (hours / product type)	0	hours / product type	70%	0.00	Time spent by Archi- tect in developing product requirement for equipment types required for the project
Avg. Time Spent Evaluating Design Schematic Drawings against Design Requirements - Space and Equipment	0	hours	90%	0.00	Average time spent by Architect in validating Design Schematic drawings before sub- mission to Owners Rep
Avg. Time spent making corrections due to non-conformance with Space or Product Program	0.0	hours	100%	0.00	Average time spent by Architect making corrections based on internal evaluation and feedback from Owners Rep.
Avg Time to Compare Design Schematic Documents with Owner Standards	0	hours	90%	0.00	Average time spent by Owners Rep in validat- ing Design Schematic documents

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Avg. Number of Re-Submit Cycles	0	Cycles	100%	0.00	Average number of times submitted documents are re-submitted
Percentage of Time Spent by Licensed Professional Architect	0%	%	-	0%	Percentage of time spent by Licensed Architect to take off all equipment pieces and to calculate areas
Percentage of Time Spent by Architect Drafter	0%	%	-	0%	Percentage of time spent by Architect Drafter to take off all equipment pieces and to calculate areas
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times schematic drawings, narratives, specifications and comments are sent and received between the Architect / Planner and Owner times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0.00	hours/submittal set	100%	0.00	Average time spent in printing and making copies of drawings, narratives and specifications by Architect / Planner
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep to Architect	-	\$ / Transmittal	100%	-	Average cost for mailing documents/comments sent between Owners Repand Architect

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Average cost for mail-

Architect to Owners Rep Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	ing docu- ments/comments between Architect and Owners Rep. Average time spent compiling copies of schematic drawings, narratives, specifica- tions and comments for transmittal by Archi- tect and Owners Rep.
Design Coordinated					
Avg. Number of Plan Drawings in Design Coordinate Drawings	0	plans / drawing set	-	0.00	Average number of Plan Drawings
Avg. Time Spent Developing Detailed Equipment (products) Type Template (hours / product)	0	hours / product	70%	0.00	Time spent by Archi- tect in preparing a de- tailed product requirement list based on equipment types
Avg. Time Searching for Product Literature for Candidates (Hours/product)	0	hours / product	90%	0.00	Average Time spent by Architect in searching for product data
Avg. Time Spent Evaluating Design Coordinated Drawings against Design Requirements - Space and Equipment	0	hours	90%	0.00	Average time spent by Architect in validating Design Coordinated drawings before sub- mission to Owners Rep
Avg. Time Spent making Corrections due to Non-Conformance with Space Program	0.00	hours	100%	0.00	Average time spent by Architect making cor- rections based on in- ternal evaluation and feedback from Owners Rep.

\$ / Transmittal

100%

Avg. Mailing Cost per Transmittal (\$ / Transmittal) -

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Avg. Percent of Errors in Product Type Candidate	0%	%	100%	0.00	Percentage of errors in Product Type List
Avg Time to Compare Design Coordinated & Product Type Candidate Documents with Owner Standards	0	hours	90%	0.00	Average time spent by Owners Rep in validat- ing Design Coordinat- ed documents
Avg. Number of Re-Submit Cycles	0	Cycles	100%	0.00	Average number of times submitted documents are re-submitted
Percentage of Time Spent by Licensed Professional Architect	0%	%	-	80%	Percentage of time spent by Licensed Architect to take off all equipment pieces and to calculate areas
Percentage of Time Spent by Architect Drafter	0%	%	-	20%	Percentage of time spent by Architect Drafter to take off all equipment pieces and to calculate areas
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times coordinated drawings, narratives, specifications and comments are sent and received between the Architect and Owners Rep times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submit- tal set	100%	0.00	Average time spent in printing and making copies of drawings, narratives and specifications by Architect

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Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep to Architect	-	\$ / Transmittal	100%	-	Average cost for mailing documents/comments sent between Architect and Owners Rep
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	-	\$ / Transmittal	100%	-	Average cost for mailing documents between Architect and Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	Average time spent compiling copies of coordinated drawings, narratives, specifications and comments for transmittal by Architect and Owners Rep
Design Final					toot and o miloto resp
Avg. Number of Plan Drawings in Design Final Drawings	0	plans / drawing set	-	0.00	Average number of Plan Drawings
Avg. Time Spent Developing Detailed Equipment (products) Type Candidate (hours / product)	0	hours / product	90%	0.00	Time spent by Architect in preparing a detailed product requirement list based on equipment types
Avg. Time Spent Evaluating Design Final Drawings against Design Requirements - Space and Equipment	0	hours	90%	0.00	Average time spent by Architect in validating Design Final drawings before submission to Owners Rep
Avg. Time Spent making Corrections due to Non-Conformance with Space or Product Program	0.00	hours	100%	0.00	Average time spent by Architect making cor- rections based on in- ternal evaluation and feedback from Owners Rep.

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Percentage of Time Spent by Licensed Professional Architect	0%	%	-	0%	Percentage of time spent by Licensed Architect to take off all equipment pieces and to calculate areas
Percentage of Time Spent by Architect Drafter	0%	%	-	0%	Percentage of time spent by Architect Drafter to take off all equipment pieces and to calculate areas
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times final drawings, narratives, specifications and comments are sent and received between the Architect and Owners Rep times the number of recipients for each exchange.
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submit- tal set	100%	0.00	Average time spent in printing and making copies of drawings, narratives and specifications by Architect / Planner
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Owners Rep to Architect	-	\$ / Transmittal	100%	-	Average cost for mailing documents/comments sent between Architect and Owners Rep
Avg. Mailing Cost per Transmittal (\$ / Transmittal) - Architect to Owners Rep	-	\$ / Transmittal	100%	-	Average cost for mailing proposal between Architect and Owners Rep.

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Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	Average time spent compiling copies of final drawings, narratives, specifications for transmittal by Architect
Request for Proposal					
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times RFP Package is sent from Owners Rep to Contractor times the number of recipients for purpose of bidding.
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0.0	hours / submit- tal set	100%	0.00	Average time spent in printing and making copies of RFP Package by Owners Rep.
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%	-	Average cost for mailing RFP by Owners Rep.
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	Time spent compiling documents, drawings or specifications for transmittal by Owners Rep.
Avg. Number of Request for Proposal Submittal Sets Reqd.	0	submittal sets	100%	0.00	Average number of RFP sets required for submission
Inquiry Issue					
Avg. Number of Transmittals	0	Transmittals	-	0.00	Average number of times Inquiry Issues and responses are sent & received between Owners Rep, Arch and Cont. times the nos of recipients for each exchange

EXPECTED ASSUMPTIONS PAGE 19 OF 28

Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%	-	Average cost for mailing documents/comments sent between Owners Rep, Architect, and Contractor
Avg. Time to Prepare Transmittals for Inquiry Issues (hours / transmittal) - Contractor / Architect	0.00	hours / transmit- tal	60%	0.00	Time spent compiling documents, drawings or specifications for transmittal by Architect and Contractor
Avg. Time to Prepare Transmittals for Inquiry Issues (hours / transmittal) - Owners Rep	0	hours / transmit- tal	60%	0.00	Time spent compiling documents, drawings or specifications for transmittal by Owners Rep.
Pre-Construction Plan					
Inquiry Issue (RFI)					
Avg. Number of RFIs	0	Transmittals	-	0.00	Average number of times Inquiry Issues (RFI) and responses are sent and received between Owners Rep, Architect and Contractor times the number of recipients for each exchange
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%	-	Average cost for mailing documents/comments sent between Owners Rep, Architect, and Contractor

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Avg. Time to Prepare Transmittals for Inquiry Issues (RFI) (hours / transmittal) - Contractor / Architect	0.00	hours / transmit- tal	60%	0.00	Average Time spent compiling Inquiry Issues (RFI) for transmittal by Architect and Contractor
Avg. Time to Prepare Transmittals for Inquiry Issues (RFI) (hours / transmittal) - <i>Owner</i>	0.00	hours / transmit- tal	60%	0.00	Average Time spent compiling Inquiry Is- sues (RFI) for transmit- tal by Owners Rep
Product Type Selection					
Time Spent Validating Equipment (products) Type against Template (hours / product)	0	hours / product	90%	0.00	Time spent by Con- tractor in comparing equipment specifica- tions against submittal information
System Layout					
Submittal Package					
Avg. Time Spent Organizing Equipment (product) Type information (hours / submittal item)	0.00	hours / submit- tal item	60%	0.00	Time spent by asst. project manager in producing submittal information by organiz- ing equipment type information
Avg. Time Spent Evaluating Equipment (product) Type Submittal Items against Contract Documents (hours / submittal item)	0	hours / submit- tal item	90%	0.00	Time spent evaluating submittal items
Avg. Time to Sign each Page (hours/page)	0.000	hours/page	100%	0.00	Average time required by Contractor to sign pages of Submittal Package
Avg. Time to Stamp each Sheet (hours / sheet)	0.000	hours/sheet	100%	0.00	Average time required by Contractor to stamp sheets of Submittal Package

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Percentage of Submittals Items rejected	0%	%	-	0%	Percentage of items rejected
Percentage of Time Spent by Construction Project Manager	0%	%	-	0%	Percentage of time spent by Construction Project Manager in validating Submittal Information
Percentage of Time Spent by Assistant (Construction) Project Manager	0%	%	-	0%	Percentage of time spent by Assistant Construction Project Manager in validating Submittal Information
Avg. Number of Transmittals	0	Transmittals	-	0	Average number of times Submittal Packages are sent and received between Owners Rep, Architect and Contractor times the number of recipients for each exchange
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0	hours / submit- tal set	100%	0	Average time spent in printing and making copies of Submittal Package by Contractor
Average Mailing Costs per Transmittal (\$)	-	\$ / Transmittal	100%	-	Average cost for Mailing documents/transmittals sent between Owners Repand Contractor
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	Average time spent compiling Submittal Package for transmittal by Architect / Contractor

Submittal Issue

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Avg. Time Spent Evaluating Product Type Submittal Items against Contract Documents (hours / product type submittal item)	0	hours / submit- tal item	90%	0.00	Average Time spent by Architect in evaluating submittal package of equipment types
Avg. Time Spent Revising one Product Submittal Item (hours / product)	0	hours / product	90%	0.00	Average Time spent by Contractor recreating Submittal Items
Percentage of Product Submittals reviewed by Licensed Architect	0%	%	-	0%	Percentage of submit- tals reviewed by Archi- tect
Percentage of Product Submittals rejected on first review	0%	%	90%	0.00%	Percentage of submit- tals rejected upon re- view
Percentage of Product Submittals rejected on second review	0%	%	100%	0%	Percentage of submit- tals rejected upon re- view
Percentage of Product Submittals rejected on third review	0%	%	100%	0%	Percentage of submit- tals rejected upon re- view
Avg. Time Spent Transferring Comments per Page	0.000	hours / submit- tal package	100%	0	Time spent by Architect in marking up submittal with comments
Avg. Time Spent Transferring Comments per Sheet	0.000	hours / submit- tal package	100%	0	Time spent by Archi- tect in marking up submittal with com- ments
Percentage of Time Spent by Construction Project Manager	0%	%	-	0%	Percentage of time spent by Construction Project Manager in recreating Submittal Package
Percentage of Time Spent by Assistant (Construction) Project Manager	0%	%	•	0%	Percentage of time spent by Assistant Construction Project Manager in recreating Submittal Package

EXPECTED ASSUMPTIONS PAGE 23 OF 28

305

Average number of

0

Avg. Time to	Prepare Transmittal (hours / transmittal)	0.000	hours / transmit-	60%	0.00	times Submittal Packages (pages and sheets) are sent and received between Architect and Contractor times the number of recipients for each exchange Average time spent compiling Submittal
						Package for transmittal
Avg. Mailing	Cost per Transmittal	-	\$ / Transmittal	100%	-	by Architect Average cost for Mailing documents/transmittals between Architect / Planner and Contractor
	Purchase Order					
	Product Installation					
	pent Re-formatting Product Installation ice (hours/ component)	0.00	hours / compo- nent	100%	0.00	Average time spent by Contractor in the office re-formatting report
Avg. Number	of Transmittals (Transmittals)	0	Transmittals	-	0.00	Average number of times Product Installation Reports are sent and received between Contractor and Architect / Owner times the number of recipients for each exchange
Avg. Mailing	Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%	-	Average cost for mailing Product Installation Report by Contractor

0

Transmittals

Avg. Number of Transmittals

EXPECTED ASSUMPTIONS PAGE 24 OF 28

Avg. Time to Prepare a Transmittal (hours/transmittal)	0.000	hours / transmit- tal	60%	0.00	Average time spent compiling Product Installation for transmittal by Assistant Construction Manager
Start-Up					
Product Inspection					
Avg. Field Time Spent Documenting Report per Site Visit (hours / visit)	0	hours / visit	60%	0.00	Average time spent in the field documenting data during site visits.
Avg. Number of Site Visits per month	0	visits / month	-	0.00	Average number of times site is visited in a month
Avg Number of Months of Construction	0	months	-	0.00	Average duration of project
Total Time Spent in Office (hours / day)	0	hours / day	-	0.00	Total time spent in the office on a daily basis
Avg. Percentage of Office Time Spent Quantifying products in place	0%	%	90%	0.00%	Average percentage of time spent in the office documenting data recorded from the field.
Avg. Number of Transmittals	0	Transmittals	·	0.00	Average number of times Product Inspection Reports are sent and received between Architect and Contractor times the number of recipients for each exchange
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%	-	Average cost for mailing Inspection Reports by Architect

EXPECTED ASSUMPTIONS PAGE 25 OF 28

Avg. Time to Prepare Transmittal (hours / transmittal)	0.000	hours / transmit- tal	60%	0.00	Average time spent compiling Inspection Report for transmittal by Architect
Punch list Issue					
Turnover Package					
Avg. Time Spent Searching and Assembling Operations & Maintenance Manuals (hours / document)	0	hours / docu- ment	90%	0.00	Time spent compiling O&M Manual
Avg. Time Spent Searching and Assembling Commissioning Report (hours / document)	0	hours / docu- ment	90%	0.00	Time spent compiling Commissioning Report
Avg. Time Spent Searching and Assembling Record Specifications (hours / document)	0	hours / docu- ment	90%	0.00	Time spent compiling Record Specifications
Avg. Time Spent Searching and Assembling Record (As-Built) Drawings (hours / sheet)	0	hours / sheet	90%	0.00	Time spent compiling Record (As-Built) Drawings
Avg. Time Spent Searching and Assembling Final Approved Shop Drawings (hours / sheet)	0.0000	hours / sheet	90%	0.0000	Time spent compiling Final Approved Shop Drawings
Avg. Number of Pages in Operations & Maintenance Manuals (pages / product)	0	pages / compo- nent	-	0.00	Number of Pages in Operations & Maintenance Manuals
Avg. Number of Pages in Commissioning Report	0	pages / compo- nent	-	0.00	Number of Pages in Commissioning Report
Avg. Number of Components & Systems to be Commissioned	0	components	-	0.00	Number of Compo- nents to be commis- sioned
Avg. Number of Pages in Record Specifications	0	pages	-	0.00	Number of Pages in Record Specifications
Avg. Number of Sheets in Record (As-Built) Drawings	0	sheets	-	0.00	Number of Sheets in Record (As-Built) Drawings

EXPECTED ASSUMPTIONS PAGE 26 OF 28

308

Avg. Number of Sheets in Final Approved Shop Drawings	0	sheets	-	0.00	Number of Sheets in Final Approved Shop Drawings
Avg. Time Spent Reviewing Operations & Maintenance Manuals (hours/page)	0.0000	hours / page	0%	0.0000	Time Spent Reviewing Operations & Mainte- nance Manuals
Avg. Time Spent Reviewing Commissioning Report (hours / page)	0.0000	hours / page	0%	0.0000	Time Spent Reviewing Commissioning Report
Avg. Time Spent Reviewing Record Specifications (hours / page)	0.0000	hours / page	100%	0	Time Spent Reviewing Record Specifications
Avg. Time Spent Reviewing Record (As-Built) Drawings (hours/ sheet)	0.0000	hours / sheet	0%	0.000	Time Spent Reviewing Record (As-Built) Drawings
Avg. Time Spent Reviewing Final Approved Shop Drawings (hours / sheet)	0.0000	hours / sheet	100%	0.000	Time Spent Reviewing Final Approved Shop Drawings
Avg. Time Spent Filing Operations & Maintenance Manuals (hours/document)	0.000	hours / docu- ment	100%	0.000	Time Spent Filing Operations & Maintenance Manuals
Avg. Time Spent Filing Commissioning Report (hours/document)	0	hours / docu- ment	100%	0.000	Time Spent Filing Commissioning Report
Avg. Time Spent Filing Record Specifications (hours/document)	0.000	hours / docu- ment	100%	0.000	Time Spent Filing Record Specifications
Avg. Time Spent Filing Record (As-Built) Drawings (hours / sheet)	0.0000	hours / sheet	100%	0.000	Time Spent Filing Record (As-Built) Drawings
Avg. Time Spent Filing Final Approved Shop Drawings(hours / sheet)	0.0000	hours / sheet	100%	0.000	Time Spent Filing Final Approved Shop Drawings
Percentage of Time Spent by Construction Project Manager	0%	%	-	0%	Percentage of time spent by Construction Project Manager in compiling Turnover Package

EXPECTED ASSUMPTIONS PAGE 27 OF 28

Percentage of Time Spent by Assistant (Construction) Project Manager	0%	%	-	0%	Percentage of time spent by Assistant Construction Project Manager in compiling Turnover Package
Avg. In-house Reproduction Time Per Submittal Set (hours/submittal set)	0.000	hours / submit- tal set	100%	0.000	Average time spent in printing and making copies of Turnover Package by Contractor
Avg. Mailing Cost per Transmittal (\$ / Transmittal)	-	\$ / Transmittal	100%	-	Average cost for mailing Turnover Package by Contractor
Avg. Time to Prepare Transmittal (hours / transmittal)	0	hours / transmit- tal	60%	0.00	Average time spent compiling Turnover Package for transmittal by Contractor

EXPECTED ASSUMPTIONS PAGE 28 OF 28

Summary Tab

Cost Summary										
OmniClass Project Phase (Table31)		Current Process		Expected Process		Savings	% Savings			
LCie 01 - Facility Criteria	\$	-	\$	-	\$	-	0%			
LCie 02 - Design Specification	\$	-	\$	-	\$	-	0%			
LCie 03 - Feasibility Study	\$	-	\$	-	\$	-	0%			
LCie 04 - Project Definition	\$	-	\$	-	\$	-	0%			
LCie 05 - Space Program	\$	-	\$	-	\$	-	0%			
LCie 06 - Product Program	\$	-	\$	-	\$	-	0%			
LCie 07 - Request for Proposal	\$	-	\$	-	\$	-	0%			
LCie 08 - Design Early	\$	-	\$	-	\$	-	0%			
LCie 09 - Design Schematic	\$	-	\$	-	\$	-	0%			
LCie 10 -Design Coordinated	\$	-	\$	-	\$	-	0%			
LCie 11 - Design Final	\$	-	\$	-	\$	-	0%			
LCie 12 - Request for Proposal	\$	-	\$	-	\$	-	0%			
LCie 13 - Inquiry Issue	\$	-	\$	-	\$	-	0%			
LCie 14 - Pre-Construction Plan	\$	-	\$	-	\$	-	0%			
LCie 15 - Inquiry Issue (RFI)	\$	-	\$	-	\$	-	0%			
LCie 16 - Product Type Selection	\$	-	\$	-	\$	-	0%			
LCie 17 - System Layout	\$	-	\$	-	\$	-	0%			
LCie 18 - Submittal Package	\$	-	\$	-	\$	-	0%			
LCie 19 - Submittal Issue	\$	-	\$	-	\$	-	0%			
LCie 20 - Purchase Order	\$	-	\$	-	\$	-	0%			
LCie 21 - Product Installation	\$	-	\$	-	\$	-	0%			
LCie 22 - Start-Up	\$	-	\$	-	\$	-	0%			
LCie 23 - Product Inspection	\$	-	\$	-	\$	-	0%			
LCie 24 - Punchlist Issue	\$	-	\$	-	\$	-	0%			
LCie 25 - Turnover Package	\$	-	\$	-	\$	-	0%			
Total	\$	-	\$	-	\$	-				

SUMMARY PAGE 1 OF 4

Breakdown by Role										
Cost Summary - Owner / Owners Rep										
OmniClass Project Phase	Current Pro	Current Process Expected Process Savings								
LCie 01 - Facility Criteria	\$	- \$	- \$	-	0%					
LCie 02 - Design Specification	\$	- \$	- \$	-	0%					
LCie 03 - Feasibility Study	\$	- \$	- \$	-	0%					
LCie 04 - Project Definition	\$	- \$	- \$	-	0%					
LCie 05 - Space Program	\$	- \$	- \$	-	0%					
LCie 06 - Product Program	\$	- \$	- \$	-	0%					
LCie 07 - Request for Proposal	\$	- \$	- \$	-	0%					
LCie 08 - Design Early	\$	- \$	- \$	-	0%					
LCie 09 - Design Schematic	\$	- \$	- \$	-	0%					
LCie 10 -Design Coordinated	\$	- \$	- \$	-	0%					
LCie 11 - Design Final	\$	- \$	- \$	-	0%					
LCie 12 - Request for Proposal	\$	- \$	- \$	-	0%					
LCie 13 - Inquiry Issue	\$	- \$	- \$	-	0%					
LCie 14 - Pre-Construction Plan	\$	- \$	- \$	-	0%					
LCie 15 - Inquiry Issue (RFI)	\$	- \$	- \$	-	0%					
LCie 16 - Product Type Selection	\$	- \$	- \$	-	0%					
LCie 17 - System Layout	\$	- \$	- \$	-	0%					
LCie 18 - Submittal Package	\$	- \$	- \$	-	0%					
LCie 19 - Submittal Issue	\$	- \$	- \$	-	0%					
LCie 20 - Purchase Order	\$	- \$	- \$	-	0%					
LCie 21 - Product Installation	\$	- \$	- \$	-	0%					
LCie 22 - Start-Up	\$	- \$	- \$	-	0%					
LCie 23 - Product Inspection	\$	- \$	- \$	-	0%					
LCie 24 - Punchlist Issue	\$	- \$	- \$	-	0%					
LCie 25 - Turnover Package	\$	- \$	- \$	-						
Total	\$	- \$	- \$	-						

SUMMARY PAGE 2 OF 4

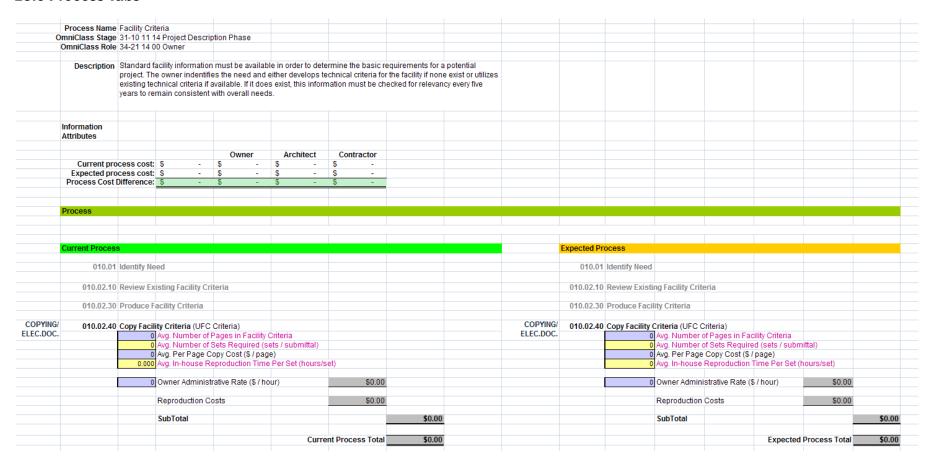
	Cost Summary - Arc	chitect		
OmniClass Project Phase	Current Process	Expected Process	Savings	% Savings by Role
LCie 01 - Facility Criteria	\$ -	\$ -	\$ -	0%
LCie 02 - Design Specification	\$ -	\$ -	\$ -	0%
LCie 03 - Feasibility Study	\$ -	\$ -	\$ -	0%
LCie 04 - Project Definition	\$ -	\$ -	\$ -	0%
LCie 05 - Space Program	\$ -	\$ -	\$ -	0%
LCie 06 - Product Program	\$ -	\$ -	\$ -	0%
LCie 07 - Request for Proposal	\$ -	\$ -	\$ -	0%
LCie 08 - Design Early	\$ -	\$ -	\$ -	0%
LCie 09 - Design Schematic	\$ -	\$ -	\$ -	0%
LCie 10 -Design Coordinated	\$ -	\$ -	\$ -	0%
LCie 11 - Design Final	\$ -	\$ -	\$ -	0%
LCie 12 - Request for Proposal	\$ -	\$ -	\$ -	0%
LCie 13 - Inquiry Issue	\$ -	\$ -	\$ -	0%
LCie 14 - Pre-Construction Plan	\$ -	\$ -	\$ -	0%
LCie 15 - Inquiry Issue (RFI)	\$ -	\$ -	\$ -	0%
LCie 16 - Product Type Selection	\$ -	\$ -	\$ -	0%
LCie 17 - System Layout	\$ -	\$ -	\$ -	0%
LCie 18 - Submittal Package	\$ -	\$ -	\$ -	0%
LCie 19 - Submittal Issue	\$ -	\$ -	\$ -	0%
LCie 20 - Purchase Order	\$ -	\$ -	\$ -	0%
LCie 21 - Product Installation	\$ -	\$ -	\$ -	0%
LCie 22 - Start-Up	\$ -	\$ -	\$ -	0%
LCie 23 - Product Inspection	\$ -	\$ -	\$ -	0%
LCie 24 - Punchlist Issue	\$ -	\$ -	\$ -	0%
LCie 25 - Turnover Package	\$ -	\$ -	\$ -	0%
Total	\$ -	\$ -	\$ -	

SUMMARY PAGE 3 0F 4

Cost Summary - Contractor										
OmniClass Project Phase	Current Process	Expected Process	Savings	% Savings by Role						
LCie 01 - Facility Criteria	\$ -	\$ -	\$ -	0%						
LCie 02 - Design Specification	\$ -	\$ -	\$ -	0%						
LCie 03 - Feasibility Study	\$ -	\$ -	\$ -	0%						
LCie 04 - Project Definition	\$ -	\$ -	\$ -	0%						
LCie 05 - Space Program	\$ -	\$ -	\$ -	0%						
LCie 06 - Product Program	\$ -	\$ -	\$ -	0%						
LCie 07 - Request for Proposal	\$ -	\$ -	\$ -	0%						
LCie 08 - Design Early	\$ -	\$ -	\$ -	0%						
LCie 09 - Design Schematic	\$ -	\$ -	\$ -	0%						
LCie 10 -Design Coordinated	\$ -	\$ -	\$ -	0%						
LCie 11 - Design Final	\$ -	\$ -	\$ -	0%						
LCie 12 - Request for Proposal	\$ -	\$ -	\$ -	0%						
LCie 13 - Inquiry Issue	\$ -	\$ -	\$ -	0%						
LCie 14 - Pre-Construction Plan	\$ -	\$ -	\$ -	0%						
LCie 15 - Inquiry Issue (RFI)	\$ -	\$ -	\$ -	0%						
LCie 16 - Product Type Selection	\$ -	\$ -	\$ -	0%						
LCie 17 - System Layout	\$ -	\$ -	\$ -	0%						
LCie 18 - Submittal Package	\$ -	\$ -	\$ -	0%						
LCie 19 - Submittal Issue	\$ -	\$ -	\$ -	0%						
LCie 20 - Purchase Order	\$ -	\$ -	\$ -	0%						
LCie 21 - Product Installation	\$ -	\$ -	\$ -	0%						
LCie 22 - Start-Up	\$ -	\$ -	\$ -	0%						
LCie 23 - Product Inspection	\$ -	\$ -	\$ -	0%						
LCie 24 - Punchlist Issue	\$ -	\$ -	\$ -	0%						
LCie 25 - Turnover Package	\$ -	\$ -	\$ -	0%						
Total	\$ -	\$ -	\$ -							

SUMMARY PAGE 4 OF 4

LCie Process Tabs



FACILITY CRITERIA PAGE 1 OF 1

D No.	Discharge Co.	0												
Process Name		specifications												
OmniClass Stage														
OmniClass Role	е													
Description	Specification	on information fo	r equipment bas	ed on facility criter	ia is generated e	arly in the planning								
				t be check for rele										
		with overall need			,,,									
	CONTONOLONIC													
Information														
Attributes														
			Owner	Architect	Contractor									
Current pr	ocess cost:	\$ -	\$ -	\$ -	\$ -									
Expected pr			\$ -	\$ -	\$ -									
Process Cost			\$ -	\$ -	\$ -									
		*		1	1									
Process														
FIUCESS														
Comment Description								5 4- d D-						
Current Proces	SS							Expected Pr	ocess					
		_												
020.0	1 Identify Ne	ed						020.01	Identify Need					
020.02.10	Review Ex	sting Discipline	Specification					020.02.10	Review Existi	ng Discipline	Specification			
020 02 30	Droduce D	iscipline Specifi	ication					020 02 30	Produce Disc	inlina Spacific	ation			
020.02.30	Froduce D	iscipilite specifi	Cauon					020.02.30	Floude Disc	apilite apecilie	auon			
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				Curre	nt Process Total	\$0.00								

DISCIPLINE SPECIFICATION PAGE 1 OF 1

	Feasibility	Study											
OmniClass Stage		•											
OmniClass Role													
Description	requireme	nts before finalizi	ing specific infor	mation about the p	project. The Archit	rree) based on the identified itect or Planner develops the ification information exchange							
Information Attributes													
			Owner	Architect/ Planner	Contractor								
Current pro	cess cost:	\$ -	\$ -	\$ -	\$ -								
Expected pro			\$ -	\$ -	\$ -								
Process Cost	Difference:	\$ -	\$ -	\$ -	\$ -								
Process													
Current Proces	s						E	xpected Pro	cess				
030.01	Receive Fa	cility Criteria an	nd Discipline Spe	ecifications				030.01	Receive Facilit	v Criteria and	d Discipline Specifi	ications	
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			d Discipline Spe	cifications Data				030.02	Dovious Facility	Criteria and	Discipline Specific	cations Data	
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FEASIBILITY STUDY PAGE 1 OF 3

HANDLING/	030.05 Send Feasibility Study			HANDLING/	030.05 Send Feasibility Study	
LEC.DOC.	Avg. Number of Transmittals (Transmittals)			ELEC.DOC.	Avg. Number of Transmittals (Transmittals)	
	\$0.00 Avg. Mailing Cost per Transmittal (\$ / Transmittal)				\$0.00 Avg. Mailing Cost per Transmittal (\$ / Transmittal)	
	0.000 Avg. Time to Prepare a Transmittal (hours/transmittal)				0.000 Avg. Time to Prepare a Transmittal (hours/transmittal)	
	\$0.00 Planner Administrative Rate (\$ / hour)	\$0.00			\$0.00 Planner Administrative Rate (\$ / hour) \$0.00	
	Mailing Costs	\$0.00			Mailing Costs \$0.00	
	SubTotal		\$0.00		SubTotal	\$0.00
ANDLING/	030.06 Log Transmittal of Feasibility Study			HANDLING/	030.06 Log Transmittal of Feasibility Study	
LEC.DOC.	O Avg. Number of Transmittals (Transmittals)			ELEC.DOC.	0 Avg. Number of Transmittals (Transmittals)	
	0.00 Time to Log (hours / transmittal)				0 Time to Log (hours / transmittal)	
	\$0.00 Planner Administrative Rate (\$ / hour)	\$0.00			\$0.00 Planner Administrative Rate (\$ / hour) \$0.00	
	SubTotal		\$0.00		SubTotal	\$0.00
	030.07 Receive Feasibility Study				030.07 Receive Feasibility Study	
ANDLING/	030.08 Log Receipt of Feasibility Study			HANDLING/	030.08 Log Receipt of Feasibility Study	
EC.DOC.	Avg. Number of Transmittals (Transmittals)			ELEC.DOC.	Avg. Number of Transmittals (Transmittals)	
	0 Time to Log (hours / transmittal)				0 Time to Log (hours / transmittal)	
	\$0.00 Owner Administrative Rate (\$ / hour)	\$0.00			\$0.00 Owner Administrative Rate (\$ / hour) \$0.00	
	SubTotal		\$0.00		SubTotal	\$0.00
	030.09 Review Feasibility Study				030.09 Review Feasibility Study	
ANDLING/	030.10.20 Send Comments to Planner			HANDLING/	030.10.20 Send Comments to Planner	
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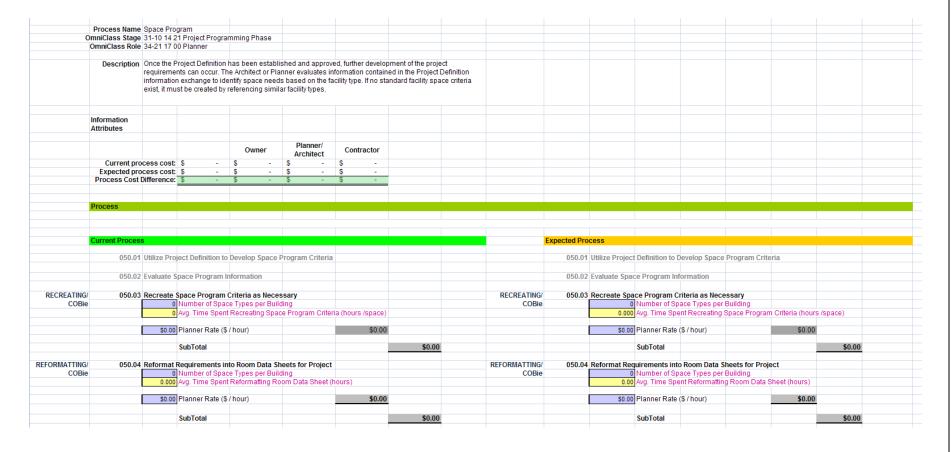
FEASIBILITY STUDY PAGE 2 OF 3

	030.11 Receive Feasibility Review Comments				030.11	Receive Feasibility Review Comments			
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	030.13 Revise Feasibility Study				030.13	Revise Feasibility Study			
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FEASIBILITY STUDY PAGE 3 OF 3

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PROJECT DEFINITION PAGE 1 OF 1



SPACE PROGRAM PAGE 1 OF 3

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PRODUCT PROGRAM

PAGE 1 OF 3

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PRODUCT PROGRAM

PAGE 2 OF 3

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PRODUCT PROGRAM

PAGE 3 OF 3

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REQUEST FOR PROPOSAL PAGE 1 OF 2

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REQUEST FOR PROPOSAL PAGE 2 OF 2

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	080.09 Produce De	sign Early Documents					080.09	Produce Design Early Docu	iments			
	080.10 Receive Co	nsultant's Early Design D	ocuments				080.10	Receive Consultant's Early	Design Documents			
	080.11 Produce Ch	eckset of Design Early D	ocuments				080.11	Produce Checkset of Desi	gn Early Documents			
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PAGE 2 OF 5

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HANDLING/	080.15 Log Receipt of Design Early Documents			HANDLING/	080.15	Log Receipt	of Design Early Documents		
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PAGE 4 OF 5

	080.24 Receive Design Early Documents				080.24	Receive Design Early Docu	ıments		
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NDLING/	080.27 Send Comments to Design Team			HANDLING/	080.27	Send Comments to Design	n Team		
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COBie	000.10		king corrections due to non-confor	rmance with Space or P	roduct Program	COBie	000.10	0.00 Avg. Time spent making corrections due to non-confo	rmance with Space	or Product Pro
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HANDLING/	090.15 Send Revised Design Schematic Documents		HANDLING/	090.15 Send Revised	Design Schematic Documents		
ELEC.DOC.	Avg. Number of Transmittals (Transmittals)		ELEC.DOC.		vg. Number of Transmittals (Transmittals)		
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	090.17 Receive Design Early Documents			090.17 Receive Desig	n Early Documents		
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HANDLING/	090.18 Log Receipt of Design Schematic & Product Type Template	Documents	HANDLING/	090.18 Log Receipt o	f Revised Design Schematic Documents		
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	100.05 Produce Checkset of Design Coordinated Documents			100.05 Produce Ch	eckset of Design Coordinated Documents	
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	100.18 Receive Design Early Documents			100.18 Re	eceive Des	gn Early Documents		
HANDLING/	100.19 Log Receipt of Revised Design Coordinated & Product Type Car	ndidate Documents	HANDLING/	100.19 Lo	og Receipt	of Revised Design Coordinated & Product Type	Candidate Docu	ments
ELEC.DOC.	Avg. Number of Transmittals (Transmittals)		ELEC.DOC.		0	Avg. Number of Transmittals (Transmittals)		
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COBie	Avg Time to Compare Design Coordinated & Product	Type Candidate Documents with Owner Standards	COBie		0.00	Avg Time to Compare Design Coordinated & Pro	duct Type Cand	date Documents with Owner Standard
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HANDLING/	100.21 Send Comments to Design Team		HANDLING/	100.21 Se	end Comm	ents to Design Team		
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PAGE 1 OF 3

	110.04 Produce (Check Set of De	esign Final Documents				110.04 Produ	ce Check Set of De	sign Final Documents		
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CREATING/	110.06.10 Make Cor	rections				RECREATING/	110.06.10 Make	Corrections			
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	110.07 Receive Design Final and Pro	duct Type Candidate Documents			110.07 F	Receive De	sign Final and	Product Type	Candidate De	ocuments		
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PAGE 3 OF 3

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REQUEST FOR PROPOSAL PAGE 1 OF 2

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REQUEST FOR PROPOSAL PAGE 2 OF 2

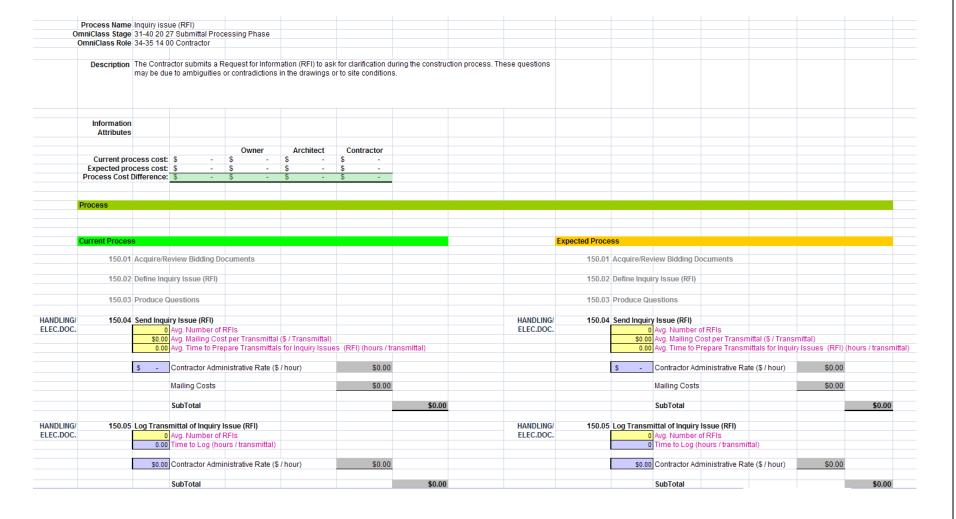
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HANDLING/	130.07	Log Receipt of Inquir	y Issue (Clarification)				HANDLING/	130.07	Log Receipt	of Inquiry Iss	sue (Clarification	n)		
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		\$0.00 Owners R	Rep. Administrative Rate	(\$7 Hour)	\$0.00				\$0.00	owners Rep.	Administrative F	Rate (\$7 flour)	\$0.00	
		Mailing C	osts		\$0.00				1	Mailing Costs	3		\$0.00	
		SubTotal				\$0.00				SubTotal				\$0.00
HANDLING/	130.09		quiry Issue (Clarification				HANDLING/	130.09			y Issue (Clarific			
ELEC.DOC.			ber of Transmittals (Tra	nsmittals)			ELEC.DOC.				of Transmittals			
		0 Time to L	og (hours / transmittal)						0	Time to Log (hours / transmit	tal)		
		\$0.00 Owners R	Rep. Administrative Rate	(\$ / hour)	\$0.00				\$0.00	Owners Rep.	Administrative F	Rate (\$ / hour)	\$0.00	
						** **								40.00
		SubTotal				\$0.00			,	SubTotal				\$0.00
	130.10	Receive Inquiry Issu	e (Clarification)					130.10	Receive Inqu	iry Issue (Cl	arification)			
HANDLING/	130 11	Log Receipt of Inquir	y Issue (Clarification)				HANDLING/	130 11	Log Receipt	of Inquiry les	sue (Clarification	2)		
ELEC.DOC.	130.11		ber of Transmittals (Tra	nemittale)			ELEC.DOC.	130.11			of Transmittals			
ELECIDOGI			og (hours / transmittal)	iioiiiittaio)			EEEGIDOOI				hours / transmit			
			- <u>- , , , , , , , , , , , , , , , , , ,</u>									,		
		\$0.00 Architect [Orafter Rate (\$ / hour)		\$0.00				\$0.00	Architect Drai	ter Rate (\$ / hou	r)	\$0.00	
		SubTotal				\$0.00				SubTotal				\$0.00
	130.12	Review Inquiry Issue	(Clarification)					130.12	Review Inqui	ry Issue (Cla	rification)			
HANDLING/	130.13	Send Inquiry Issue (Clarification) Response				HANDLING/	130.13	Send Inquiry	Issue (Clari	ication) Respor	ise		
ELEC.DOC.			ber of Transmittals (Tra				ELEC.DOC.				of Transmittals			
		\$0.00 Avg. Mailir	ng Cost per Transmittal	(\$ / Transmittal)								ittal (\$ / Transm	ittal)	
		0.000 Avg. Time	to Prepare Transmittals	s for Inquiry Issues	(hours / transmittal)			0.000	lvg. Time to	repare Transm	ittals for Inquiry I	lssues (hours / t	transmittal)
		\$0.00 Architect [Orafter Rate (\$ / hour)		\$0.00				\$0.00	Architect Draf	ter Rate (\$ / hou	r)	\$0.00	
			·											
		Mailing C	osts		\$0.00				ı	Mailing Cost	3		\$0.00	
		SubTotal				\$0.00				SubTotal				\$0.00
		SubTotal				\$0.00				SubTotal				\$0.00

HANDLING/	130.14	Log Transmittal of Inquiry Issue (Clarification) Respons	se		HANDLING/	130.14	Log Transmittal of Inquiry Issue (Cla	arification) Response	
LEC.DOC.		Avg. Number of Transmittals (Transmittals)			ELEC.DOC.		0 Avg. Number of Transmi		
		Time to Log (hours / transmittal)					0 Time to Log (hours / tran	ismittal)	
		\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00				\$0.00 Architect Drafter Rate (\$	/ hour) \$0.00	
		SubTotal		\$0.00			SubTotal		\$0.00
	130.15	Receive Response to Inquiry Issue (Clarification) from	Architect			130.15	Receive Response to Inquiry Issue (Clarification) from Architect	
ANDLING/	130.16	Log Receipt of Response of Inquiry Issue (Clarification))		HANDLING/	130.16	Log Receipt of Response of Inquiry	Issue (Clarification)	
LEC.DOC.		Avg. Number of Transmittals (Transmittals)			ELEC.DOC.		0 Avg. Number of Transmi	ttals (Transmittals)	
		Time to Log (hours / transmittal)					Time to Log (hours / tran	ismittal)	
		\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00				\$0.00 Architect Drafter Rate (\$	/ hour) \$0.00	
		SubTotal		\$0.00			SubTotal		\$0.00
	130.17	Review Responses to Inquiry Issue (Clarification)				130.17	Review Responses to Inquiry Issue	(Clarification)	
HANDLING/	130.18	Send Inquiry Issue (Clarification) Response to Contract	tor		HANDLING/	130.18	Send Inquiry Issue (Clarification) Re	sponse to Contractor	
ELEC.DOC.		Avg. Number of Transmittals (Transmittals)			ELEC.DOC.		0 Avg. Number of Transmi		
		\$0.00 Avg. Mailing Cost per Transmittal (\$ / Transm					\$0.00 Avg. Mailing Cost per Tra		
		0.000 Avg. Time to Prepare Transmittals for Inquiry	Issues (hours / transmittal)				0.000 Avg. Time to Prepare Tra	nsmittals for Inquiry Issues (hour	s / transmittal)
		\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00				\$0.00 Owners Rep. Administra	ative Rate (\$ / hour) \$0.00	
		Mailing Costs	\$0.00				Mailing Costs	\$0.00	
		SubTotal		\$0.00			SubTotal		\$0.00
HANDLING/	130.19	Log Transmittal of Inquiry Issue (Clarification) Respons	se		HANDLING/	130.19	Log Transmittal of Inquiry Issue (Cla	arification) Response	
ELEC.DOC.		Avg. Number of Transmittals (Transmittals)			ELEC.DOC.		Avg. Number of Transmi		
		Time to Log (hours / transmittal)					Time to Log (hours / tran	ismittal)	
		\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00				\$0.00 Owners Rep. Administra	ative Rate (\$ / hour) \$0.00	
		SubTotal		\$0.00			SubTotal		\$0.00
	130.20	Receive Inquiry Issue (Clarification) Response				130.20	Receive Inquiry Issue (Clarification)	Response	
HANDLING/	130.21	Log Receipt of Inquiry Issue (Clarification) Response			HANDLING/	130.21	Log Receipt of Inquiry Issue (Clarific	cation) Response	
ELEC.DOC.		Avg. Number of Transmittals (Transmittals)			ELEC.DOC.		0 Avg. Number of Transmi	ttals (Transmittals)	
		Time to Log (hours / transmittal)					0 Time to Log (hours / tran	ismittal)	
		\$0.00 Contractor Administrative Rate (\$ / hour)	\$0.00				\$0.00 Contractor Administrative	e Rate (\$ / hour) \$0.00	
		SubTotal		\$0.00			SubTotal		\$0.00
			Current Process Total	\$0.00				Expected Process Total	\$0.00
			Current Process Total	\$0.00				Expected Process Total	\$0.00

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ing Phase						
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valan a Dan Opportunitan Diag	- tht-d	-4				
f the facility. This is sent as a s	n that describes how the Contra submittal package. Refer to the Id handling Pre-Construction Pl	submittal Package				
Owner Architect	Contractor					
	\$ -					
- \$ -	\$ -					
- \$ -	\$ -					
		Expected F	rocess			
nents		14	0.01 Review Specificat	ion Requirements		
1		14	0.02 Develop Pre-Cons	truction Plan		
		14	0.03 Submittal Process	6		
Curre	ent Process Total \$	-			Expected Process Total	\$ -
	Curre	Current Process Total \$	Current Process Total \$ -	Current Process Total \$ -	Current Process Total \$ -	Current Process Total S - Expected Process Total

PRE-CONSTRUCTION PLAN PAGE 1 OF 1



INQUIRY ISSUE (RFI) PAGE 1 OF 4

	150.06 Receive Inquiry Issue (RFI) from Contractor			150.06 Receive Inquiry Issue (RFI) from Contractor	
HANDLING/	150.07 Log Receipt of Inquiry Issue (RFI)		HANDLING/	150.07 Log Receipt of Inquiry Issue (RFI)	
ELEC.DOC.	O Avg. Number of Transmittals (Transmittals)		ELEC.DOC.	0 Avg. Number of Transmittals (Transmittals)	
	0.00 Time to Log (hours / transmittal)			0 Time to Log (hours / transmittal)	
	\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00		\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00
	Sold Owners (tep. / tellimistrative (tate (p / floar)	\$ 6.55		56.00 OWNERS RES. Naministrative Plate (\$711001)	\$6.00
	SubTotal	\$0.00		SubTotal	\$0.00
HANDLING/	150.08 Send Inquiry Issue (RFI) to Architect		HANDLING/	150.08 Send Inquiry Issue (RFI) to Architect	
ELEC.DOC.	0 Avg. Number of RFIs		ELEC.DOC.	0 Avg. Number of RFIs	
	\$0.00 Avg. Mailing Cost per Transmittal (\$ / Transmittal)			\$0.00 Avg. Mailing Cost per Transmittal (\$ / Transm	ittal)
	0.000 Avg. Time to Prepare Transmittals for Inquiry Issues	(RFI) (hours / transmittal)		0.000 Avg. Time to Prepare Transmittals for Inquiry	Issues (RFI) (hours / transmittal)
	S - Owners Rep. Administrative Rate (\$ / hour)	\$0.00		S - Owners Rep. Administrative Rate (\$ / hour)	\$0.00
	Mailing Costs	\$0.00		Mailing Costs	\$0.00
	SubTotal	\$0.00		SubTotal	\$0.00
HANDLING/	150.09 Log Transmittal of Inquiry Issue (RFI)		HANDLING/	150.09 Log Transmittal of Inquiry Issue (RFI)	
ELEC.DOC.	0 Avg. Number of RFIs		ELEC.DOC.	0 Avg. Number of RFIs	
	0 Time to Log (hours / transmittal)			0 Time to Log (hours / transmittal)	
	\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00		\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00
	SubTotal	\$0.00		SubTotal	\$0.00
	150.10 Receive Inquiry Issue (RFI)			150.10 Receive Inquiry Issue (RFI)	
HANDLING/	150.11 Log Receipt of Inquiry Issue (RFI)		HANDLING/	150.11 Log Receipt of Inquiry Issue (RFI)	
ELEC.DOC.	0 Avg. Number of RFIs		ELEC.DOC.	0 Avg. Number of RFIs	
	0 Time to Log (hours / transmittal)			0 Time to Log (hours / transmittal)	
	\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00		\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00
	SubTotal	\$0.00		SubTotal	\$0.00
	150.12 Review Inquiry Issue (RFI)			150.12 Review Inquiry Issue (RFI)	

INQUIRY ISSUE (RFI) PAGE 2 OF 4

HANDLING/		ry Issue (RFI) Response		HANDLING/	150.13 Send Inquiry Issue (RFI) Response	
ELEC.DOC.	0	Avg. Number of RFIs		ELEC.DOC.	0 Avg. Number of RFIs	
		Avg. Mailing Cost per Transmittal (\$ / Transmittal)			\$0.00 Avg. Mailing Cost per Transmittal (\$ / Trans	
	0.00	Avg. Time to Prepare Transmittals for Inquiry Issue	es (RFI) (hours / transmittal)		0.00 Avg. Time to Prepare Transmittals for Inquir	y Issues (RFI) (hours / transmittal)
	\$0.00	Architect Drafter Rate (\$ / hour)	\$0.00		\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00
		Mailing Costs	\$0.00		Mailing Costs	\$0.00
		SubTotal	\$0.00		SubTotal	\$0.00
		SubTotal	\$0.00		SubTotal	\$0.00
ANDLING/ LEC.DOC.		mittal of Inquiry Issue (RFI) Response Avg. Number of RFIs		HANDLING/	150.14 Log Transmittal of Inquiry Issue (RFI) Response O Avg. Number of RFIs	
EC.DUC.		Time to Log (hours / transmittal)		ELEC.DOC.	0 Time to Log (hours / transmittal)	
	U	Time to Log (nodis / transmittar)			o Time to Log (nodis / transmittar)	
	\$0.00	Architect Drafter Rate (\$ / hour)	\$0.00		\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00
		SubTotal	\$0.00		SubTotal	\$0.00
	150.15 Receive R	esponse to Inquiry Issue (RFI) from Architect			150.15 Receive Response to Inquiry Issue (RFI) from Architect	
ANDLING/		ot of Response of Inquiry Issue (RFI)		HANDLING/	150.16 Log Receipt of Response of Inquiry Issue (RFI)	
LEC.DOC.	0	Avg. Number of RFIs		ELEC.DOC.	0 Avg. Number of RFIs	
	0	Time to Log (hours / transmittal)			Time to Log (hours / transmittal)	
	\$0.00	Owners Rep. Administrative Rate (\$ / hour)	\$0.00		\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00
		SubTotal	\$0.00		SubTotal	\$0.00
	150.17 Review Re	sponses to Inquiry Issue (RFI)			150.17 Review Responses to Inquiry Issue (RFI)	
ANDLING/		ry Issue (RFI) Response to Contractor		HANDLING/	150.18 Send Inquiry Issue (RFI) Response to Contractor	
LEC.DOC.		Avg. Number of RFIs		ELEC.DOC.	0 Avg. Number of RFIs	
		Avg. Mailing Cost per Transmittal (\$ / Transmittal)			\$0.00 Avg. Mailing Cost per Transmittal (\$ / Trans	
	0.00	Avg. Time to Prepare Transmittals for Inquiry Issue	es (RFI) (hours / transmittal)		0.000 Avg. Time to Prepare Transmittals for Inquir	y Issues (RFI) (hours / transmittal)
	\$0.00	Owners Rep. Administrative Rate (\$ / hour)	\$0.00		\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00
		Mailing Costs	\$0.00		Mailing Costs	\$0.00
		SubTotal	\$0.00		SubTotal	\$0.00
ANDLING/	150.19 Log Trans	mittal of Inquiry Issue (RFI) Response		HANDLING/	150.19 Log Transmittal of Inquiry Issue (RFI) Response	
LEC.DOC.	0	Avg. Number of RFIs		ELEC.DOC.	0 Avg. Number of RFIs	
	0	Time to Log (hours / transmittal)			0 Time to Log (hours / transmittal)	
	\$0.00	Owners Rep. Administrative Rate (\$ / hour)	\$0.00		\$0.00 Owners Rep. Administrative Rate (\$ / hour)	\$0.00
		SubTotal	\$0.00		SubTotal	\$0.00

INQUIRY ISSUE (RFI) PAGE 3 OF 4

	150.20 Receive I	nguiry Issue (RFI	from Owner					150.20	Receive Ing	uiry Issue (RF	I) from Owner			
HANDLING/							HANDLING/							
ELEC.DOC.	150.21 Log Rece	ipt of Inquiry Issu	ie (RFI) Response				ELEC.DOC.	150.21			ue (RFI) Respo	nse		
		Avg. Number of								Avg. Number				
		Time to Log (ho	urs / transmittal)						0	Time to Log ((hours / transmi	ttal)		
	\$0.0	Contractor Adm	inistrative Rate (\$	/ hour)	\$0.00				\$0.00	Contractor Ad	dministrative Ra	te (\$ / hour)	\$0.00	
		SubTotal				\$0.00				SubTotal				\$0.00
				Curre	ent Process Total	\$0.00						Expected	Process Total	\$0.00
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INQUIRY ISSUE (RFI) PAGE 4 OF 4

Process Name P mniClass Stage 3			ressing Ph	1256											
OmniClass Role 3			cessing rii	lase											
Jillilliciass Role 3	4-33 14 0	O CONTRACTOR													
						oducts identified									
						ange for detailed	requirements re	lated to							
tr	ansmittin	g and handling	Product Typ	pe Sele	ction submittals.										
Information															
Attributes															
			Own		Architect	Contractor									
Current proce			-	-		\$ -									
Expected proce	ess cost:	\$ -		-	\$ -	\$ -									
Process Cost Di	ference:	\$ -	\$	-	\$ -	\$ -									
Process															
Current Process									Expected Proce	ess					
160.01 R	eview Co	ntract Docume	ents						160.01	Review Contra	act Documents				
160.02 V	alidate S	ubmittal Inform	ation						160.02	Validate Subn	nittal Informatio	n			
100.02									. 50.02	- Induto odbii					
400.00									400.00						
160.03 S	ubmittal	Process							160.03	Submittal Pro	cess				
				Curro	nt Process Tota	\$ -						Expected	Process Total	\$ -	
				curre	III FIUCESS IUIA	-						Expected	FIOCESS TOTAL	-	

PRODUCT TYPE SELEECTION PAGE 1 OF 1

Process Name															
mniClass Stage	31-40 20 27 8	Submittal Proces	ssing Phase												
OmniClass Role			_												
Description	The Centract	r and Sub Con	tractore review i	nformation for r	araduete identifie	d in the Design Fin	al decuments								
					mange for detail	ed requirements re	elated to								
	transmitting a	nd handling Sy:	stem Layout sub	omittals.											
Information															
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Attributes															
			Owner	Architect	Contractor										
C	4 6														
	cess cost: \$		\$ -												
Expected pro	cess cost: \$	-			\$ -										
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rocess															
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arrent rocess								Expedical Food	33						
470.04	Di	4 Di						470.04	D i C t	4 D					
1/0.01	Review Contr	act Drawings						170.01	Review Contrac	t Drawings					
170.02	Lavout and R	oute Building S	vstem					170.02	Layout and Rou	te Building Syste	em				
			,												
470.02	Overlay Syste	em Layouts (Sh	on Drawingo)					470.02	Overlay System	Lavoute / Chon	Drawingo)				
170.03	Overlay Syste	em Layouts (Si	iop Drawings)					170.03	Overlay System	Layouts (Snop	Drawings)				
170.04	Identify Syste	em Interference	es					170.04	Identify System	Interferences					
110101	identity byst							110101	identity bystem	meericies					
470.05	D							470.05	D	1-4					
1/0.05	Resolve Syst	em Interferenc	es					1/0.05	Resolve System	ninterrerences					
		ma I accounte / Cla	on Drawinge)					170.06	Update System	Layouts (Shop [Drawings)				
	Update Syste	m Layouts (Sn	op brawings)												
	Update Syste	m Layouts (Sn	op brawings,												
170.06			op Drawings)					470.07.40	Cultimittal Deser	200					
170.06	Update Syste		op Drawnigs)					170.07.10	Submittal Proce	ess					
170.06			op brawings)					170.07.10	Submittal Proce	ess					
170.06			op brawings)	Curr	rent Process To	tal \$ -		170.07.10	Submittal Proce	988		Expected	Process Total \$	-	
170.06			op brawings)	Curr	rent Process To	tal \$ -		170.07.10	Submittal Proce	988		Expected	Process Total \$	-	
170.06			op brawniga)	Curi	rent Process To	tal \$ -		170.07.10	Submittal Proce	ess		Expected	Process Total \$	-	
170.06			op brawniga)	Curi	rent Process To	stal s -		170.07.10	Submittal Proce	255		Expected	Process Total	-	

SYSTEM LAYOUT PAGE 1 OF 1

		Submittal P													
			7 Submittal Proc	essing Phase											
OmniC	lass Role	34-35 14 0	0 Contractor												
De	scription	The Contra	ctor organizes t	he required subn	nittal information and c	reates Submittal	Packages to be reviewed by the								
			nd/or Owner's F				•								
	Informatio														
,	Attributes														
				Owner		Contractor									
_			_		Architect										
		ess cost:		\$ -	\$ -	\$ -									
		ess cost:		\$ -	<u> </u>	\$ -									
Proce	ss Cost D	ifference:	\$ -	\$ -	\$ -	\$ -									
	Process														
	Current Pr	rocess								xpected Process					
	180.01	Identify S	ubmittal Dates	on Submittal F	Register					180.01 Identify Sub	mittal Dates on Submittal	Register			
	180.02.10	Receive 9	ubmittal Infor	mation from Su	b-Contractors and	Vendors				180.02.10 Receive Sub	omittal Information from S	ub-Contractors and Vendors			
ANDLING/	180.02.15	Log Rece	ipt of Submitta	l Package from	Sub-Contractors a	nd Vendors			HANDLING/	180.02.15 Log Receipt	of Submittal Package from	m Sub-Contractors and Vendo	ors		
LEC.DOC.				Transmittals (Transmittals)					ELEC.DOC.		0 Avg. Number of Transmittal				
		0.00		urs / transmittal)							Time to Log (hours / transm				
			Table to Log (inc									,			
		\$0.00	Contractor Adm	inistrative Rate (S / hour)	\$0.00				\$0.0	Contractor Administrative R	ate (\$ / hour)	\$0.00		
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			SubTotal				\$0.00				SubTotal			\$0.00	
			SubTotal				\$0.00				SubTotal			\$0.00	
	180.02.20		Submittal Infor							180.02.20 Produce Su					
COBie					Types (Types / project				COBie		Number of Equipment (prod				
		0.00	Avg. Time Spen	t Organizing Equ	ipment (product) Type	information (hou	rs / submittal item)			0.0	 Avg. Time Spent Organizing 	Equipment (product) Type inform	ation (hours / sub	mittal item)	
		\$0.00	Assistant (Cons	struction) Project	Manager Rate (\$ / hou	\$0.00				\$0.0	Assistant (Construction) Pr	oject Manager Rate (\$ / hour)	\$0.00		
			SubTotal				\$0.00				SubTotal			\$0.00	
LIDATING/	180.03	Validate 9	ubmittal Infor	mation against	Contract Documen	ts			VALIDATING/	180.03 Validate Sul	bmittal Information agains	t Contract Documents			
COBie					Types (Types / project				COBie		Number of Equipment (prod				
		0					gainst Contract Documents (hou	rs / submittal item)	2.5010			Equipment (product) Type Submitt	tal Items against C	Contract Documents (hour	rs / submitta
		0%		Submittals Items r							Percentage of Submittals Ite				
		0%	Percentage of T	Time Spent by Co.	nstruction Project Man	ager						y Construction Project Manager			
		0%	Percentage of 1	Time Spent by As	sistant (Construction)	Project Manager						v Assistant (Construction) Project	t Manager		
		0/.	, or contage of 1	and Spont by As	owani (construction)	, roject manager				0,	. Croomage of Time Spent to	, Assistant (construction) Project	managor		
		40.00	Construction De	-i N D-	-t- (8 (b)	60.00				400	Carata atian Basis at Managa	D-t- (8 (b)	60.00		
				oject Manager Ra		\$0.00					Construction Project Manag		\$0.00		
			Assistant (Cons	struction) Project	Manager Rate (\$ / hou	\$0.00				\$0.0	I Assistant (Construction) Pr	oject Manager Rate (\$ / hour)	\$0.00		
		\$0.00													
		\$0.00	SubTotal		,		\$0.00				SubTotal			\$0.00	

SUBMITTAL PACKAGE PAGE 1 OF 3

	180.04 Produce Submittal Package			180.04 Pro	oduce Submittal Package			
COPYING/	180.05 Copy Submittal Package		COPYING/	180.05 Co	py Submittal Package			
ELEC.DOC.	0 Avg. Number of Submittal Pages in a Submittal Item (pages)	nes/submittal item)	ELEC.DOC.			tal Pages in a Submittal Item (pages/s	submittal item)	
	Avg. Number of Submittal Sheets in a Submittal Item (she					tal Sheets in a Submittal Item (sheets/		
	0 Avg. Number of Submittal Items in a Submittal Package f	or each Equipment (product) Type (submittal it	tems/submittal package)		Avg. Number of Submit	tal Items in a Submittal Package for ea	ach Equipment (product) Type (submittal ite	ms/submittal package
	Number of Equipment (product) Types (Types / project)					product) Types (Types / project)	7,7	
	Number of Submittal Sets Regd. (sets / submittal)					ts Regd. (sets / submittal)		
	\$0.00 Avg. Per Page Copy Cost (\$ / page)				\$0.00 Avg. Per Page Copy Co			
	\$0.00 Avg. Per Sheet Copy Cost (\$ / sheet)				\$0.00 Avg. Per Sheet Copy C			
	0.00 Avg. In-house Reproduction Time Per Set (hours/set)					ction Time Per Set (hours/set)		
	\$0.00 Contractor Administrative Rate (\$ / hour)	\$0.00			\$0.00 Contractor Administration	ve Rate (\$ / hour)	\$0.00	
	Copying Cost	\$0.00			Copying Cost		\$0.00	
	SubTotal	\$0.00			SubTotal		\$0.00	
	Subiotal	\$0.00			SubTotal		\$0.00	
HANDLING/	180.06 Stamp Submittal Package		HANDLING/	180.06 Sta	mp Submittal Package			
ELEC.DOC.	 Avg. Number of Submittal Pages in a Submittal Item (pages) 		ELEC.DOC.			tal Pages in a Submittal Item (pages/s		
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	SubTotal	\$0.00			SubTotal		\$0.00	
HANDLING/	180.07 Send Submittal Package		HANDLING/	180.07 Ser	nd Submittal Package			
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HANDLING/	180.08 Log Transmittal of Submittal Package		HANDLING/	180.08 Loc	g Transmittal of Submittal Pack	age		
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SUBMITTAL PACKAGE PAGE 2 OF 3

	180.09 Receive Submittal Package				180.09	Receive Submittal Package			
ANDLING/	180.10 Log Receipt of Submittal Package			HANDLING/	180.10	Log Receipt of Submittal Package			
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	180.11 Review Submittal Package				180 11	Verify Submittal Package			
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ANDLING/	180.12 Send Submittal Package to Architect			HANDLING/	180.12	Send Submittal Package to Architec			
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	180.14 Receive Submittal Package				180.14	Receive Submittal Package			
ANDLING/	180.15 Log Receipt of Submittal Package			HANDLING/	180.15	Log Receipt of Submittal Package			
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	180.16 Submittal Issue				180.16	Submittal Issue			
		Current Process Total	\$0.00				Expected Pro	ocess Total	\$0.00

SUBMITTAL PACKAGE PAGE 3 OF 3

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OmniC	Class Role 34-35 14	00 Contractor														
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SUBMITTAL ISSUE PAGE 1 OF 3

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	\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00			\$0.00 Architect Drafter Rate (\$	/ hour)	\$0.00	
	Mailing Cost	\$0.00			Mailing Cost		\$0.00	
	SubTotal	\$0.00			SubTotal		\$0.00	
	SubTotal	30.00			SubTotal		30.00	
HANDLING/ 190.03.2	0 Log Transmittal of Submittal Issues		HANDLING/	190.03.20	Log Transmittal of Submittal Issue:			
ELEC.DOC.	Avg. Number of Transmittals (Transmittals)		ELEC.DOC.	TOUTOULE	0 Avg. Number of Transmit			
	0 Time to Log (hours / transmittal)				0 Time to Log (hours / trans	mittal)		
	\$0.00 Architect Drafter Rate (\$ / hour)	\$0.00			\$0.00 Architect Drafter Rate (\$	/ hour)	\$0.00	
	0.17-4-1	40.00			0.17-4-1		40.00	
	SubTotal	\$0.00			SubTotal		\$0.00	
400.0	4 Receive Submittal Issue			400.04	Receive Submittal Issue			
130.0	4 Receive Submittal Issue			130.04	Receive Submittal Issue			
HANDLING/ 190.0	5 Log Receipt of Submittal Issue		HANDLING/	190.05	Log Receipt of Submittal Issue			
ELEC.DOC.	O Avg. Number of Transmittals (Transmittals)		ELEC.DOC.		0 Avg. Number of Transmit	als (Transmittals)		
	0 Time to Log (hours / transmittal)				0 Time to Log (hours / trans			
	\$0.00 Contractor Administrative Rate (\$ / hour)	\$0.00			\$0.00 Contractor Administrative	Rate (\$ / hour)	\$0.00	
	SubTotal	60.60			SubTotal		40.00	
	SUD I OTAI	\$0.00			SubTotal		\$0.00	
490.0	6 Review Submittal Package			490.06	Review Submittal Package			
130.0	o neview subilitial rackage			130.00	Review Submittal Package			
	Culpé	otal (1st Review Total) \$0.00				Subtotal (1st Revi	ew Total) \$0.00	

SUBMITTAL ISSUE PAGE 2 OF 3

	yout)	t Type Selection, System Lay			RECREATING/				190.06.10 Recreate Submittal Pac	
		luct) Types (Types / project)			COBie			pment (product) Types (Types / project		COBie
		one Product Submittal Item (hours						nt Revising one Product Submittal Item (I		
		by Construction Project Manager						Time Spent by Construction Project Man		
	ject Manager	by Assistant (Construction) Proje	Percentage of Time Spent b	0%			Project Manager	Time Spent by Assistant (Construction)	0≥ Percentage of	
	\$0.00	per Date (\$ / hour)	Construction Project Manag	* 0.00			\$0.00	oject Manager Rate (\$ / hour)	#0.00 Construction Pr	
	\$0.00	roject Manager Rate (\$ / hour					\$0.00	struction) Project Manager Rate (\$ / hou		
	30.00	oject manager Rate (37 nour	Assistant (Construction) Fit	\$0.00			\$0.00	struction) Project manager Rate (\$7 not	\$0.00 Assistant (Cons	
	\$0.00		SubTotal				\$0.00		SubTotal	
									200	
		mittals rejected on 2nd review	Percentage of Product Subi	0%				Product Submittals rejected on 2nd revi	W Percentage of F	
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
40.00	\$0.00	Contractor's Cost				40.00	\$0.00	Contractor's Cost		
\$0.00						\$0.00				
		mittals rejected on 3rd review	Percentage of Product Subi	0%				Product Submittals rejected on 3rd revie	W Percentage of F	
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
\$0.00	\$0.00	Contractor's Cost				\$0.00	\$0.00	Contractor's Cost		
30.00		mittals rejected on 4th review	Percentage of Product Sub-	05/		30.00	W	Product Submittals rejected on 4th revie	0½ Percentage of 0	
	\$0.00	Architect's Cost	r or contago of Froduct Subi	07.			\$0.00	Architect's Cost	Wi rercentage of r	
	\$0.00	Contractor's Cost					\$0.00	Contractor's Cost		
\$0.00		Communication of Country				\$0.00	Q0.00	Contractor a cost		
\$0.00	Process Total	Expected P				\$0.00	nt Process Total	Curre		
		- Even-stad aven-saat	Flan Day					Flan Dan Comment museum and		
		c Expected process cost: 2nd review	Elec. Doc					Elec. Doc Current process cost: 2nd review		
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
	\$0.00	Contractor's Cost					\$0.00	Contractor's Cost		
	30.00	Contractor's Cost					30.00	Contractor's Cost		
		3rd review						3rd review		
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
	\$0.00	Contractor's Cost					\$0.00	Contractor's Cost		
	30.00	Contractor a coat					30.00	Contractor a cost		
		4th review						4th review		
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
	\$0.00	Contractor's Cost					\$0.00	Contractor's Cost		
\$0.00	tect's Sub Total					\$0.00	rchitect's Sub Total			
\$0.00	ctor's Sub Total	Contract				\$0.00	ntractor's Sub Total	Co		
		e Expected process cost:	COR					COBie Current process cost:		
		e Expected process cost: 2nd review	COBIE					2nd review		
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
	\$0.00	Contractor's Cost					\$0.00	Contractor's Cost		
	\$0.00	Contractor's Cost					\$0.00	Contractors Cost	 	
		3rd review						3rd review		
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
	\$0.00	Contractor's Cost					\$0.00	Contractor's Cost		
	90.00	3030001 3 0000					40.00	COMMUNICION & COST		
		4th review						4th review		
	\$0.00	Architect's Cost					\$0.00	Architect's Cost		
	\$0.00	Contractor's Cost					\$0.00	Contractor's Cost		
\$0.00	tect's Sub Total	Archite				\$0.00	rchitect's Sub Total	A		

SUBMITTAL ISSUE PAGE 3 OF 3

Process Name	Purchase	Order													
mniClass Stage	31-40 20 2	7 Submittal Proce	essing Phase												
OmniClass Role	34-35 14 0	0 Contractor													
			Supplier to order												
			ment and/or mate												
	and/or mat	terials in the quot	e against approve	ed submittal docu	mentation and	d then submits	a Purcha	ise Order.							
Information															
Attributes															
			Owner	Architect	Contract	or.									
Current proc	ace ract	S -		S -		-									
Expected proc				S -		-									
Process Cost Di			S -	S -		-									
		•													
Process															
Current Proces	ss								Expected Prod	ess					
200.01	Contact 9	Supplier							200.01	Contact St	ıpplier				
200.02	Request	Quote and Tech	nnical Data						200.02	Request G	uote and T	echnical Data			
200.03	Receive (Quote and Tech	nical Data						200.03	Receive Q	uote and Te	echnical Data			
200.04	Submit T	echnical Data fo	or Approval						200.04	Submit Te	chnical Dat	a for Approva	ı		
200.05	Receive A	Approval							200.05	Receive A	pproval				
200.06	Issue Pu	rchase Order							200.06	Issue Pur	chase Orde	r			
200.07	Send Pur	chase Order ar	nd Approved Pr	oduct Type Sel	ection to Su	pplier			200.07	Send Purc	hase Order	and Approve	ed Product Ty	pe Selection	to Supplier
			Curren	t Process Total	\$	-						Expected P	rocess Total	S -	

PURCHASE ORDER PAGE 1 OF 1

		Product Insta		- Dh											
		31-40 40 11 ° 34-35 14 00 (n Phase											
Ollill	iiciass Roie	34-33 14 00 (Dominacion												
[ent, materials, and sys t data and manufactur		esign final								
		urawings, ap	proved Snop	drawings, produc	t data and mandiactur	ers msuucuons.									
	Information														
	Attributes														
				Owner	Architect	Contractor									
		cess cost: \$			\$ -	\$ -									
		cess cost: \$		\$ - \$ -	\$ - \$ -	\$ - \$ -									
PIO	ocess cost b	merence. 5	-	Φ -	5 -	5 -									
	Process														
	Current Pro	cess							Expected F	rocess					
	210.01	Receive Equi	nment and N	laterials					210.01	Receive Equi	nment and Ma	aterials			
		Review Purc		interiors						Review Purc		atoriais			
				t and Materials					210.03.10	Log Receipt	of Equipment	and Materials			
	210.03.11	Review Manu	ıfacturer's Ir	nstallation Instruc	tions				210.03.11	Review Manu	rfacturer's Ins	stallation Inst	ructions		
	210.03.12	Install Equipr	nent, Materia	als and Building S	systems - Recording	Component Data			210.03.12	Install Equipr	nent, Material	s and Buildin	g Systems - Recording Com	ponent Data	
RMATTING/	210.04	Reformat Pro						REFORMATTING/		Reformat Pro					
COBie					(components / project roduct Installation Rep		rs/ component)	COBie					nents (components / project) ting Product Installation Repo		s/ comp
		\$0.00 As	sistant (Con	struction) Project	Manager Rate (\$ / hou	r \$0.00				\$0.00	Assistant (Co	onstruction) P	oject Manager Rate (\$ / hou	\$0.00	
			ıbTotal				\$0.00				SubTotal				9
HANDLING/	210.05			Poport to Archite	ect / Owners Rep		\$0100	HANDLING/	240.05	Sand Draduc		Poport to Arc	nitect / Owners Rep		
ELEC.DOC.	210.03			f Transmittals (Tra				ELEC.DOC.	210.03				ls (Transmittals)		
				st per Transmitta				2223.200.					smittal (\$ / Transmittal)		
					tal (hours/transmittal)								nsmittal (hours/transmittal)		
		\$0.00 Co	ontractor Adm	ninistrative Rate (/ hour)	\$0.00				\$0.00	Contractor Ad	Iministrative F	Rate (\$ / hour)	\$0.00	
		Ma	ailing Cost			\$0.00					Mailing Cost			\$0.00	
		c.	ıbTotal				\$0.00				SubTotal				\$

PRODUCT INSTALLATION PAGE 1 OF 2

HANDLING/	210.06 Lo	og Transi	mittal of Produc	t Installation Rep	ort			HANDLING/	210.06	Log Transmi	tal of Produc	t Installation R	eport			
ELEC.DOC.				Transmittals (Tra	nsmittals)			ELEC.DOC.					s (Transmittals)			
		0.00	Time to Log (ho	urs / transmittal)						0.0	Time to Log	(hours / transm	ittal)			
		\$0.00	Contractor Admi	nistrative Rate (\$	/ hour)	\$0.00				\$0.00	Contractor A	dministrative R	ate (\$ / hour)		0.00	
			SubTotal				\$0.00				SubTotal					\$0.00
	210.07 R	eceive Pr	roduct Installation	on Report					210.07	Receive Proc	luct Installati	on Report				
HANDLING/	210.08 Lo			tallation Report				HANDLING/	210.08			stallation Repo				
ELEC.DOC.				Transmittals (Tra urs / transmittal)	nsmittals)			ELEC.DOC.				of Fransmittal: (hours / transm	s (Transmittals) ittal)			
		\$0.00	Architect Drafter	Rate (\$ / hour)		\$0.00				\$0.00	Architect Dra	fter Rate (\$ / ho	our)		50.00	
			SubTotal				\$0.00				SubTotal					\$0.00
					_											
					Curre	ent Process Total	\$0.00							Expected Process	Total	\$0.00

PRODUCT INSTALLATION PAGE 2 OF 2

OmniClass Role	34-35 14 00 Cor	ntractor										
Description					quipment/systems must							
-	equipment. This	testing mu	st be completed	with the Owner's	Representative and Mar	ufacturer's repre	sentative present.					
formation tributes												
			Owner	Architect	Contractor							
	cess cost: \$	-	\$ -	\$ -	\$ -							
Expected pro	cess cost: \$	-	\$ -	\$ -	\$ -							
Process Cost	Difference: \$	-	\$ -	\$ -	\$ -							
rocess												
urrent Process							_	Expected Proce				
urrent Process								Expected Proce	:55			
220.01	Send Start-Up T	est Proced	ures and Recor	ding Forms to O	wner's Rep.			220.01	Send Start-Up Test Proced	lures and Record	ding Forms to Owner's	Rep.
220.02	Schedule Start-	Up Test wit	h Owner's Rep.					220.02	Schedule Start-Up Test wi	th Owner's Rep.		
220.03	Review Manufac	cturer's Sta	irt-Up/Operation	Instructions				220.03	Review Manufacturer's Sta	art-Up/Operation	Instructions	
220.04	Conduct Start-U	In/Test of In	stalled Fauinme	ent				220 04	Conduct Start-Up/Test of Ir	estalled Equipme	ent	
220.04	oonaaot otart-o	p. 100101111	Ctanou Equipino					220.04	oonaaot ota/t-op/100t of fi	Totalioa Equipino	2115	
220.05	Record Test Re	sults						220.05	Record Test Results			
					Current Process Tota	\$ -					Expected Proces	s Total \$ -

Process Name Start-Up
OmniClass Stage 31-40 40 11 17 Installation Phase

START - UP PAGE 1 OF 1

	Process Name															
			17 Evaluation Pha	ase												
O	mniClass Role	34-35 14 00	Contractor													
		14/h 4h - O -		-1-4-4 :4-11-4:				1 t- itt								
						or systems, a notificat										
						The Architect conduc										
						uding any deficiencie	s are identified in	the inspection								
		report, the Co	ontractor corrects	them and reque	ests a re-inspection	on.										
	Information															
	Attributes															
				Owner	Architect	Contractor										
		process cost:		\$ -		\$ -										
		process cost:		\$ -	\$ -	\$ -										
	Process Cos	st Difference:	\$ -	\$ -	\$ -	\$ -										
	rocoss									<u> </u>						
	rocess															
C	Current Process	S								Expected Pro	cess					
	230.01	Request Pro	duct Inspection							230.01	Request Prod	uct Inspection	1			
	230.02	Review Cont	ract Drawings ar	nd Product Insp	ection Report					230.02	Review Contr	act Drawings	and Product In	spection Report		
	230.03	Conduct Pro	duct Inspection							230.03	Conduct Prod	uct Inspection	1			
IATTING/	230.04		oduct Inspection						REFORMATTING/	230.04	Reformat Pro					
COBie						ite Visit (hours / visit)			COBie		0.00	Avg. Field Tim	ne Spent Docur	nenting Report per Site	Visit (hours / visit)	
					onth (visit / month						0			er month (visit / month)		
					truction (months)						0			nstruction (months)		
			Total Time Spen								0		ent in Office (h			
		0%	Avg. Percentage	of Office Time S	Spent Quantifying	products-in-place					0%	Avg. Percenta	ge of Office Tin	ne Spent Quantifying p	oducts-in-place	
			li i a a a a a d Doorfe a		D-4- (0 (b)							l : d D	f	to at Data (C (base)	60.00	
		\$0.00	Licensed Profes	sional Architect	Rate (\$ / nour)	\$0.00					\$0.00	Licensea Pro	ressional Archi	tect Rate (\$ / hour)	\$0.00	
			0.17-4-1				A 0.00					SubTotal			•	
			SubTotal				\$0.00	4				SubTotal			30	0.00
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NDLING/	230.05		t Inspection Rep						HANDLING/	230.05	Send Product					
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					al (\$ / Transmittal) ttal (hours/transm									nittal (\$ / Transmittal) smittal (hours/transmit	n)	
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		\$0.00	Architect Drafter	Rate (\$ / hour)		\$0.00					\$0.00	Architect Drof	ter Rate (\$ / ho	ur)	\$0.00	
		30.00	Architect Dialier	rvate (#/110ul)		\$0.00					\$0.00	A CHILLEGE DI AI	ici ivaic (\$7110	urj	90.00	
			Mailing Cost			\$0.00						Mailing Cost			\$0.00	
			mailing oost			Ψ0.00						alling Cost			90.00	
			SubTotal				\$0.00					SubTotal				0.00

PRODUCT INSPECTION PAGE 1 OF 2

HANDLING/	230.06			Inspection Report				HANDLING/	230.06			Inspection Re			
ELEC.DOC.				f Transmittals (Tra	nsmittals)			ELEC.DOC.					(Transmittals)		
		0.00	Time to Log (h	ours / transmittal)						0	Time to Log (hours / transm	ttal)		
		\$0.00	Architect Drafte	er Rate (\$ / hour)		\$0.00				\$0.00	Architect Draf	ter Rate (\$ / ho	ur)	\$0.00	
			SubTotal				\$0.00				SubTotal				¢ 0.00
			SubTotal				\$0.00				SubTotal			_	\$0.00
	230.07	Receive Prod	duct Inspection	Report					230.07	Receive Prod	luct Inspection	Report			
HANDLING/	230.08		of Product Insp					HANDLING/				pection Report			
ELEC.DOC.				f Transmittals (Tra	nsmittals)			ELEC.DOC.					(Transmittals)		
		0	Time to Log (h	ours / transmittal)						0	Time to Log (hours / transm	ttal)		
		\$0.00	Contractor Adn	ninistrative Rate (\$	/ hour)	\$0.00				\$0.00	Contractor Ad	Iministrative Ra	te (\$ / hour)	\$0.00	
			SubTotal				\$0.00				SubTotal				\$0.00
	230.09	Review Prod	luct Inspection	Report					230.09	Review Produ	ict Inspection	Report			
	230.10	Correct Defic	ciencies						230.10	Correct Defic	iencies				
	230.11	Request Re-i	inspection						230.11	Request Re-in	nspection				
					C	Current Process Total	\$0.00						Expected	d Process Total	\$0.00

PRODUCT INSPECTION PAGE 2 OF 2

Process Name													
nniClass Stage	31-40 40 91	17 Evaluation F	Phase										
mniClass Role	34-35 14 00	Contractor											
D	The Archite	t arastas a final	l nunchliet bee			fthe completed or	noter etion work						
						f the completed co							
						chlist. The Archited							
	Contractor h	nas corrected the	e deficiencies i	in the pun	chlist by p	performing a final	walkthrough.						
							_						
Information													
Attributes													
			Owner	Arc	chitect	Contractor							
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Current proc				\$		\$ -							
Expected proc			\$ -	\$	-	\$ -							
Process Cost D	ifference:	\$ -	\$ -	\$	-	\$ -							
							-						
Process													
Current Process								Expected Pro	cess				
240.01	Request Pu	nchlist Issue In	spection					240.01	Request Pun	chlist Issue Ins	spection		
240.02	Review Cor	tract Drawings						240.02	Review Contr	ract Drawings			
240.02	Conduct Du	nchlist Issue In	onootion					240.03	Conduct Dun	chlist Issue Ins	pootion		
240.03	Conduct Pu	nchiist issue in	ispection					240.03	Conduct Pun	Chilist issue ilis	pection		
240.04	Reformat P	unchlist Issue F	Report					240.04	Reformat Pui	nchlist Issue R	enort		
2101011	torormatr	unomiot roodo r	toport					210101	rtorormat r a	TOTAL TO GO TE	oport		
240.05	Send Puncl	nlist Issue Repo	ort to Contracto	or				240.05	Send Punchli	ist Issue Repor	t to Contractor		
0.10.00	_							0.10.00					
240.06	Log Transn	nittal of Punchli	st Issue Repor	t				240.06	Log Transmit	ttal of Punchlis	t Issue Report		
240.07	Pocoivo Du	nchlist Issue Re	pport					240.07	Docoivo Duna	chlist Issue Re	nort		
240.07	Neceive Fu	ilcilliat iaaue ive	ероп					240.01	Neceive Full	cilliat iaaue ive	port		
240.08	Log Receip	t of Punchlist Is	sue Report					240.08	Log Receipt of	of Punchlist Iss	sue Report		
240.00	D i D	- I-E-41 D						0.0000	D D.	LE-41			
240.09	Keview Pur	ichlist Issue Re	port					240.09	Review Punc	hlist Issue Rep	оп		
	Correct Det	iciencies						240 40	Correct Defic	riencies			
240 40 4		ICICIICIES						240.10	COLLECT DELLC	Jenes			
240.10													
240.10													
		-inspection						240.11	Request Re-i	nspection			
		-inspection						240.11	Request Re-i	nspection			
		-inspection		rent Proc				240.11	Request Re-i	nspection		ted Process Total	

PUNCHLIST ISSUE PAGE 1 OF 1

	1 100000 Humo															
0	mniClass Stage	31-40 40 9	11 17 Evaluation	Phase												
)	OmniClass Role	34-35 14 0	0 Contractor													
	Description	The Contr	actor nathers all t	the ac-huilt inform	ation related to the	e project and for	wards the information to the owner.									
	Description	THE COIL	actor gatricis arr	uie as-built illioill	iation related to ti	ie project and io	wards are information to the owner.									
	Information															
	Attributes															
				Owner	Architect	Contractor										
	Current pro	case cost	s -	S -	\$ -	S -										
	Expected pro			\$ -												
				5 -	5 -	5 -										
	Process Cost [omerence:	\$ -	\$ -	\$ -	\$ -										
	Process															
	Current Process	5							Expected Process							
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		0					(hours / document)					and Assembling Record S				
		U					(nours / document)							s / document)	
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		0	Avg. Number of	Sheets in Final A	pproved Shop Dra	awings				Avg. Number	of Sheets in Fi	nal Approved Shop Drawi	ngs			
		0.00	Ava. Time Spen	t Searching and A	ssembling Final	Approved Shop [Drawings (hours / sheet)		0.000	Ava. Time Sp	ent Searching:	and Assembling Final App	proved Shop Drawin	nas (hours / s	heet)	
		0%		ime Spent by Cor								y Construction Project Ma				
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		076	r ercentage or r	inte openi by Ass	istant (Constituct	on) Froject mana	igei		0	Fercentage	n tillie openiu	y Assistant (Constituction)	rrojeci wanayer			

				oject Manager Ra		\$0.00						er Rate (\$ / hour)	\$0.00			
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ELEC.DOC.				Pages in Operati			es / product)	ELEC.DOC.				erations & Maintenance I		oduct)		
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		0		Components & S								s & Systems to be Comm				
		0		Pages in Record								cord Specifications				
		0		Sheets in Record								ecord (As-Built) Drawings				
		0														
		0		Sheets in Final A		wings						nal Approved Shop Drawi	ngs			
				mittal Sets Reqd.								eqd. (sets / submittal)				
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TURNOVER PACKAGE PAGE 1 OF 2

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HANDLING/	250.06	Log Peceir	ot of the Turnover Package			HANDLING/	250.06	Log Peceint	of the Turnover Package			
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			Avg. Number of Pages in Commissioning Report						Avg. Number of Pages in Co			
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REPORT DOCUMENTATION PAGE

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Added Benefit of a COBie Prod	cess	5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
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13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Construction Operations Building information exchange (COBie) standard defines a minimum set of information needed to capture electronic construction handover information. COBie, however, does not define the specific processes used to create such information. Some designers and contractors may choose to capture the data by mirroring current document-based processes, transcribing information from required paper documents into a COBie-formatted file following beneficial occupancy. Other designers and contractors may choose to capture this information as data, as the work progresses, using COBie-centered project extranets. This report examines the costs and benefits of each approach, and compares them by analyzing differences in each business process that uses COBie information. The results indicate that a significant benefit may be achieved through the elimination of the non-value-added activities related to the handling, routing, transforming, checking, copying, and transmitting documents containing COBie data.

15. SUBJECT TERMS

Construction Operations Building information exchange (COBie), Building Information Modeling (BIM), value-added analysis, business processes, project management

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